

# Aviation Week

*and Space Technology*

75 Cents

A McGraw-Hill Publication

October 16, 1961

Special Report,  
Photos of ARS  
Display, Meeting

GE T64 Turboprops  
On de Havilland Caribou



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the reliability of missile switches ...



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**Honeywell**

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## CAPABILITY is spelled s-e-r-v-i-c-e

Aerospace components—even those with the highest order of reliability—must be backed by an organization capable of providing all the requirements of a complete service program.



At Eastern Air Lines Miami base Howard Crothers of Vickers checks installation of DC 6-B pump at service test unit with E. Nichols, foreman, and J. Schmitt, test assistant.

Proposed modification of units for improved service and reduced maintenance is discussed with EAL engineers Moody and Young.

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Proper overhaul and parts inspection instructions are observed by A. Wingard, general foreman of assembly overhaul for Eastern Air Lines.

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## AVIATION CALENDAR

- Oct. 21-24-Latest Meeting, Canadian Aeronautical Institute/Institute of the Aeronautics, Montreal, Quebec, Canada
- Oct. 23-24-International Aviation Navigation Council, European Regional Meeting, Paris, France
- Oct. 23-25-East Coast Conference on Aeronautics and Navigation Electronics, in conjunction with Radio Engineers, Long Beach Hotel, Long Beach, CA
- Oct. 24-25-26th Annual General Meeting, International Air Transport Association, Geneva, Switzerland
- Oct. 25-Nov. 3-Worldwide Tolls 1960, IATA/Intercontinental Wharves, Montreal, Quebec, Canada
- Oct. 25-26-27th Traffic Conference, Air Transport Association, Montreal, Quebec, Canada
- Oct. 26-27-International Symposium on Navigation Systems, Paris, France
- Oct. 26-27-28th Annual General Meeting, International Air Transport Association, Geneva, Switzerland
- Oct. 28-29-30th Annual Meeting, American Helicopter Association, Phoenix, Arizona
- Oct. 29-30-31st Annual Meeting, American Helicopter Association, Phoenix, Arizona
- Oct. 31-1st Annual Meeting, American Helicopter Association, Phoenix, Arizona

## AVIATION WEEK and Space Technology

October 16, 1960  
Vol. 74, No. 34

AVIATION WEEK and Space Technology is a weekly publication that contains the latest news, analysis, and commentary on the aerospace industry. It covers a wide range of topics, including aircraft development, space exploration, and defense technology. The publication is known for its in-depth reporting and expert analysis, making it a valuable resource for industry professionals and enthusiasts alike.

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How often have you forecast your company's future on the basis of incomplete information? Estimates of the existing market, arbitrary definitions of its composition, guesses on your share, someone else's thinking on its trends.

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October 16, 1961

# Aviation Week

## and Space Technology

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**COVER** General Electric T56 turboprop engine on flight tested for the first time on Sept. 22 in the presence of a 100,000-foot crowd of Canada's 12,000 troops. Royal Canadian Air Force C-119 transport aircraft was used to transport the engine to the test site. The test was rated "completely satisfactory" by General Electric and its officials.

**RESEARCH**  
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## Education's Role in Space

Dr. James A. Van Allen, head of the physics department at the State University of Iowa and discoverer of the earth's satellite belts, told the American Rocket Society's Space Flight Report to the nation last week that there is a "great chasm" between the nation's ambitions in space and its competence to fulfill them. He also suggested some solutions. Because of the importance of Dr. Van Allen's remarks to the national space effort, *Aerospace Week* is publishing the text of his speech.

If an unbiased, intelligent person (from Mars, let us say) were to survey the progress of our current Space Flight Report to the Nation, he would be entitled to the impression that the space program of the United States is presently in the hands of the agencies of the federal government and of large industrial establishments—and that universities play a minor and perhaps peripheral role in this great enterprise.

The impression would also be gained from a consideration of the program of other major engineering societies. And indeed, in the course of the past few years this impression contains a large element of truth. It is therefore proper to inquire whether the colleges and universities of our country do have a vital role in space science and technology. I believe that the answer to this inquiry is affirmative, but I do not consider that this answer is altogether obvious. Hence my remark.

First, let me note that the educational system—and in particular that component of it which results in higher education—provides the essential intellectual groundwork for most scholarly, scientific and technological activities of any culture.

We witness today what I regard as "the great chasm" in our space program. We are aware on a daily basis of an intense enthusiasm and interest in space exploration by the population of the nation and by the general public. This may perhaps be measured by noting that we have numerous and rapidly growing ambitions in the field of space exploration, both manned and unmanned. Yet, we must confess to a level of overall competence which is far short of these ambitions.

There are many brilliant achievements in this field. Yet there is, from a scholar's point of view, a striking paucity of solid, fundamental interest in space flight and a similar lack of interest in basic aspects of the subject. One is sorely aware of this when he undertakes to provide an interested group of students with a reading list which will carry them from the rudiments of the subject to a level of genuine understanding—from which understanding original contributions of a substantial sort may be expected to emerge.

Moreover, many practitioners exhibit only the most superficial familiarity with the literature which does exist.

In short, our national ambitions have greatly outstripped our national competence. We can therefore continue to muddle along in this style in a more or less creditable way for awhile—especially since our international competition reflects from the most acutely. But in due course, our efforts will become less and less imaginative and

successful and more and more pedestrian—even though technically proficient in the limited sense. The shaded role of the universities is thus to put the fine cutting edge on the massive and relatively blunt intellectual tools which we are using.

This can be done in two ways. First, we must rapidly assume the responsibility for converting the ebb and flow or less halfhearted interest and enthusiasm of our youth to solid competence. This is not an easy matter. The effects of this effort, vital as it is, will not be immediate. We are overwhelmed with false prophecies and spurious advice. The most "authoritative advice" comes from those who are most remote from the classroom and academic laboratory. By and large laymen do not attempt to tell a surgeon how to conduct an operation, or a navigator how to steer a ship, or a planner how to craft a joint. But everyone is an expert on education.

Those who have direct daily responsibility for classroom instruction are the first to admit that the education of young people is one of the most diverse of human enterprises. Yet, by and large, colleges and universities have brought our culture to where it is today, and no other segment of our culture, as yet, has demonstrated a comparable level of capability in transforming the interest and enthusiasm of youth into broad-based leadership.

We believe that we can continue to do so in the space science field though we do not possess overnight miracles. And we will need substantial federal assistance if we are to match the national ambitions in this new field of human endeavor.

Secondly, I believe that the first graduate colleges of our universities have the potential for contributing in an essential, direct, and enlightening way to fundamental advances in space science and, perhaps to a lesser extent, in space technology. The number of universities which have thus far done so may possibly be counted on the fingers of two hands and those which have actually been present "on the firing line" in an essential way are even fewer.

Yet is a matter of national policy, if for no other reason, that this situation be drastically improved. Only if universities are fully engaged partners in the national space effort can we develop the broad-based, long-term competence which the public and the Congress is justlyly expect. I commend this subject to the National Science Foundation, to the National Aeronautics and Space Administration, and to congressional segments of the Department of Defense, such as the Office of Naval Research, for their sympathetic consideration.

We do not need gimmicks. But we do need facilities. We need research support, we need to establish a favorable competitive situation for the maintenance of a professional faculty and staff, and we need student fellowships. The cost is a minuscule fraction of the national space budget. I believe that the results will be strikingly impressive.

## BFG FUEL CELLS FIT T-38 LIKE A GLOVE TO INCREASE RANGE

In innovative air-to-air combat, the first essential fuel cells of the Northrop T-38 were built at Westfield, Mass. by BFG Goodrich. These fuel cells are a simple, lightweight, and reliable power source for the aircraft. They are used to power the engine, the avionics, and the weapons.

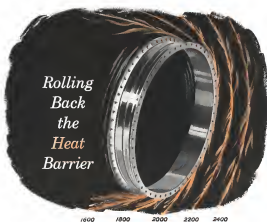
These BFG cells are produced in very close cooperation with the aircraft manufacturer. In fact, the aircraft manufacturer is responsible for the design, development, and production of the fuel cells. BFG Goodrich is responsible for the design, development, and production of the fuel cells.

BFG Goodrich maintains complete fuel cell test and development facilities and has extensive experience in design and production of cells for aircraft, missiles, and ground vehicles. For complete information contact BFG Goodrich Aerospace and Defense Products, a division of The BFG Goodrich Company, Dept. AF-100, Akron, Ohio.

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aerospace and  
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Manufacture uses roller to shape turbine and compressor blades of Haynes X-40 alloy.

Address inquiries to Haynes Stellite Company,  
270 Park Avenue, New York 17, N.Y.

The output power of modern 50,000-pound thrust jet engines is being harnessed effectively by critical parts made of Haynes high-temperature alloys. Turbine and stress are typical of the hot spots in which these alloys serve. Here, in the face of turbine and rings, they contain the hot combustion gases as they flow through the various turbine stages.

In these, and in other parts too, such as afterburner liners, flame holders, throats, and investment-cast turbine blades and nozzle vanes, Haynes alloys are meeting the punishing effects of long hours at high temperatures. In fact, one of the Air Force's latest 1500-MPH jets uses six different HAYNES alloys in vital parts where heat and stress would weaken and destroy other materials.

Whether investment- or sand-cast, rolled, wrought, vacuum melted, or hot rolled, there's a HAYNES high-temperature alloy to meet your needs.

**HAYNES**  
ALLOYS  
HAYNES STELLITE COMPANY  
Division of Union Carbide Corporation  
Kalamazoo, Indiana

UNION  
CARBIDE

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## Washington Roundup

### New Budget Emphasis

Budget deliberations inside the National Aeronautics and Space Administration, Postage and White House are going beyond specific spending requests and focusing increasingly on their impact on the overall U. S. economy.

This emphasis is part of the Kennedy Administration's attempt to harness space and military spending to its economic recovery effort. President Kennedy's Council of Economic Advisors is leading a new study of the impact of this type of spending. One spokesman told Aviation Week the council is also trying to get "a detailed snapshot" of the national economy in the late 1950s to its own determine how much space and military spending the U. S. can afford.

Some military leaders are complaining that this new economic atmosphere is handicapping their weapons experts and giving the edge to budgeters in current Pentagon spending debates. NASA leaders, in contrast, are capitalizing on the Administration's economic interest by pointing out how space spending is uplifting depressed areas of the U. S.

### IAF Congress Site

Next year's International Astronautical Congress will be in Sebe, Belgium—the first ever to be held in an Iron Curtain country. It is scheduled for mid-October. The 1961 congress will be in Buenos Aires, Argentina. Mexico, Yugoslavia, West Germany and Poland also offered to serve as hosts for the 1962 meeting.

Debate over who should own and operate the communications satellite system continues without letup throughout the congressional session. Chairman Russell B. Long of the Senate aerospace subcommittee will receive his hearings on the subject Nov. 3 and plans to call in all Federal Communications Commission members as well as industry leaders interested in developing the system.

Background for the hearings will be communications industry's own recommendations to FCC on system ownership. Revival of congressional activity is accompanied by debates among private groups about communications satellites. The issue, for example, has split Astronautics for Democratic Action, which wants public ownership and the Communication Workers (AFL-CIO), whose president and top people development will oppose the U. S. as it is left with the system.

Soviet delegates to the International Astronautical Congress displayed interest in the Naval Research Laboratory's work with very low frequency radio propagation data obtained with the Lullia satellite. Vladimir A. Krut'chenko, Soviet spokesman, said no similar experiments have been conducted with Russian satellites. But he said he hoped to do so in the future if VLF signals can communicate with satellites halfway around the world.

### SAGE Dispute

Argument between the Air Force and Federal Aviation Agency over the future use of SAGE aircraft computers is delaying the release of the long-contested Project Beacon report on air traffic control. An Air Force need for the expensive computer system is disheartening. Several Air Force leaders are getting FFA to use the system first as a traffic control. But the Project Beacon report recommends against this. FAA Administrator N. E. Haislip, who so far has been unable to attract Air Force engineers to this recommendation, now hints he may release Project Beacon as it stands.

National Aeronautics and Space Administration is trying to keep private industry informed of its scheduled backlog in the space program program. John Burke, vice president of the Bechtel Corp. of Los Angeles, has secured a four-month assignment with the agency to help do this.

### Mayor's Choice

Mayor Robert F. Wagner of New York passed up his scheduled welcoming address to the American Rocket Society's Space Flight Report to the Nation (see p. 27) so he could meet the U. S. Air Force's first Space Flight Report to the Nation. The mayor told the city council of his "personal admiration for the agency and confidence of the American by industry through the years."

Chief of Naval Operations recently received the vice from the Naval Medical School at Pensacola, Fla. Request authority for civilian Man Jerre Cobb to fly in Naval aircraft for purpose of baseline studies designed to determine fundamental differences between male and female astronauts.

The reply: "If you don't know the difference, surely, we refuse to put any money into the project." —Washington Staff

# ARS Underscores U.S. Space Goals, Gaps

**New York exhibit indicates nation's ambitions, but unsuitable for major achievements hinges on boosters.**

New York—Mockups and models dramatized the American Rocket Society Space Flight Report to the Nation last week, demonstrating not only the nation's glowing and growing ambitions in space but also the distance it must travel to turn concepts into hardware to fulfill those ambitions.

This gap was underscored by Dr. James A. Van Allen, discoverer of the earth's ionosphere belts, who used his occasional topic of education for space science and technology and the role of universities in space research (see p. 21) as a basis for comments on broader aspects of the nation's space programs. Therein, he said, a "great chasm" separates the "various and rapidly growing" activities in the field of space exploration, both manned and unmanned, and the nation's competence to achieve those ambitions.

Though all Dr. Van Allen's comments were not unreservedly shared here, speeches, technical sessions and discussions by leaders of the country's space effort all recognized the magnitude of a gap between present and potential. One year after Sputnik I, for example, the primary limiting factor in the U.S. program still is powerplants, and the national booster program is spread out with uncertainties.

Such basic decisions as whether man will be placed on the moon by direct flight or through the use of orbital rendezvous, what type of vehicle will be used for the mission, and how long the Apollo spacecraft must wait may have to be decided before the Apollo program can be fully realized.

Key to these questions will be the report of the Large Launch Vehicle Group headed by Dr. Nicholas Collins of National Aeronautics and Space Administration, which is due to report by Nov. 1. This is a joint Defense Department-NASA group, and final decisions on powerplants, as all thrust changes have been withheld for 60 days.

Most of the basic decisions affecting the Apollo and its boosters for various missions are expected to be made by the end of this year.

Feasibility that NASA will shift its Apollo manned lunar landing mission from direct ascent to rendezvous was apparent in remarks made by NASA Administrator James E. Webb and Wernher von Braun, director of the agency's Marshall Space Flight Center.

Von Braun and the flight technicians under direct consideration for the Apollo lunar mission have narrowed to:

- Payload assembly in orbit, using four Saturn C-3 boosters, each of which would carry 190,000 lb. rate as earth orbit.
- Use of the Saturn C-4 on two assembly-orbit flights. The C-4, using a cluster of four Rocketdyne F-1 engines, doubles the C-3 payload. Saturn C-5 is a cluster of two F-1 engines.
- Direct ascent, with a Nike vehicle

based on a booster cluster of eight F-1 engines. Nike could carry the 160,000 lb. Apollo payload in one direct flight.

The Apollo spacecraft configuration cannot be frozen until decisions are made on the exact NASA will follow in the mission trajectory, but Webb said the F-1 engine is the power plant, the spacecraft is not.

NASA last week reserved Apollo spacecraft proposals from five contracting firms, headed by General Dynamics, General Electric, Martin, McDonnell and North American (AW Sept. 4, p. 31). Each team made oral presentations and the written and oral material went to a NASA source selection board late last week. Webb and von Braun while contract will be awarded before the end of the month.

Von Braun said the basic flight trajectory decision will leave NASA will build either the C-3 or C-4 Saturn vehicle, but not both. Webb, who has not moved on reports that since September to coordinate NASA studies on rendezvous (AW Sept. 18, p. 25) and recently in detail potentially in the future, but, dropped and most reliable flight techniques for manned lunar landings.

The problem, according to von Braun, is that all aspects of rendezvous are not understood.

NASA plans to evaluate rendezvous with at least one mission during Project 1962, with two programs being considered. One involves an attempt to join an Agena chase vehicle with a Project Mercury capsule, and the other is to use a Scout launch vehicle to join with a Mercury capsule target. The agency will spend \$5 million on rendezvous development during the fiscal year.

Webb cautioned that rendezvous could not be done and possibly two years from the manned lunar landing timetable over a direct ascent, but the smaller F-1 booster cluster will be available before the next-generation Nike.

Complaining the NASA decision is

the solid propellant Nike program. The solid Nike is being developed under Air Force Systems Command main agreement to NASA's specifications in a qualified program with the liquid-fueled Nike under development by NASA.

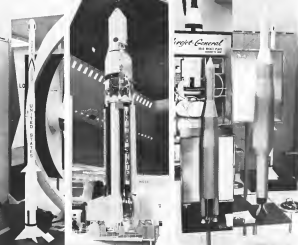
An Agena is evolving a family of smaller solid propellant launch vehicles, called Stratol Launch Vehicles (SLV), and the solid-rocket technique instead of the numerous, multi-fueled stages of the 25 million lb. thrust Nike. Using clustered 120-in.-dia. in the first stage, but single 120-in. capsules as the upper stage, USAF is advancing the argument that this system would give improved launch capability in shorter time, remote launch vehicle reliability and simpler guidance and control problems.

An Agena also is investigating the upper stage launch stage that can carry payloads in space. Lang-Tenno-Vought described an experimental mission system being developed under Armstrong Source Division sponsorship that would permit a new approach to payload of 600. Some bioproduction systems indicated that USAF is interested in learning more's servicer/booster under very high loads, since this is considered one of the major factors of manned spacecraft activity. USAF's philosophy apparently is that the higher the loads that the pilot can take, the wider the mission corridor, the wider the corridor, the less expenditure the guidance and control and maneuver correction propellant systems. The simpler these systems are, the lighter their weight, the fewer the weight and complexity, in fact, will simplify the rendezvous operations and the logistics involved in assembling the launch vehicle and spacecraft and launch, reduce the time necessary to develop the rendezvous mission vehicle.

NASA takes the opposite Apollo specifications, for example, call for a crew to experience less than 12g on its return to earth after a lunar landing or circumlunar mission. This latter, explained with a 1500-ship weight of 4.5, will necessitate a cruise between 30 and 35 mi. into a small target that will require a new precise guidance and control system and a new vehicle maneuver system capable of 10-min. burning time. NASA's approach is more cautious and has a lower risk factor, but in other respects relies on accuracy and longer lead times.

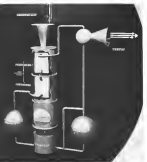
Contrasts between the proponents of liquid and solid propellant vehicles still continue, with both sides able to show continuing advances on their own rockets.

By now, both sides have learned



## Finned Saturn Boosters at ARS

Armstrong proposed the expanded program for the Space Scout vehicle, left would give payload capability of 1,000 lb. in 300 and one solid finned Saturn model (above, center) shows addition of eight aerodynamic sections the structural stability. Armstrong conceptual model (right) shows variation in size of weight-bearing design, using standard vehicle (middle) and solidly integrated, cast-in-place propellant type Saturn design, left would be 190 ft. high, one at right, 250 ft. high.



Boosting model (above) shows 12-man pressurized space station for 300-ton net orbit. Marquardt Corp. liquid-fueled engine is shown discontinuously at left.

five either system in the near future in the problems. Current estimation of population is that for space flight is being considered in the early stages of the program to be flown. These studies at this stage of space development clearly indicate the need for the broad, propellant high-capacity system in the near future for upper stages of space vehicles.

But selection is not as simple as it seemed for other stages of space vehicles. Currently the choice is heavily weighted on the side of the liquid-propellant system, primarily because it has demonstrated a longer history of experience and performance than the large solid-type (Rocketdyne's F-2) engine, rated at 1.5 million lb thrust in a given program with a sizable amount of strength, there are three chamber and modular engines behind it. The engine's F-2 upper stage is now operating on liquid hydrogen and liquid oxygen and developing 100,000 lb thrust, a well advanced development.

#### Solid Rocket Technology

Solid rocket technology in contrast, still has to produce the large diameter, high-thrust, long-burn-time, space program. Separated rockets appear now to offer the most promising solution, but so far the largest was fired—Boeing's General's 180-in. engine—developed 250,000 lb of thrust, a far cry from the million lb thrust needed for space vehicles.

The problem is complicated by a number of factors which reflect as

consider the real difficulties of the system problem, and the complexity of the overall system required.

Development time and cost are important, but not overriding considerations in the final choice of propulsion system. Other issues, namely, site, stage building, vehicle complexity, structure and guidance considerations and maintenance of the launch process exist.

The evidence now available, and NASA's Elmer Mitchell, does not demonstrate the superiority of either approach. There is further argument within the ranks of the solid-propellant proponents, who are split generally into two camps: those who believe large engines can best be made in one piece, and those who feel only the segmented approach is viable. William Cohen also is pro-segment, pointed out that there is no propellant plant in existence that can make a motor containing a million pounds of propellant, and that it is taking 15 ft. in diameter by 70 ft. long.

New techniques of on-site mixing and pouring, setting the enormous grain overnight in a flowable latex for casting, and then curing it for better temperature to the final state, have been suggested as possible solutions.

Segmented engines cut in pieces and transported to the launch site by the millions and being, against the general approach taken by the proponents of the one-piece engine. Then as the development of suitable joints between adjacent segments moves into 10 lb of reliability can be reached which are

not inferior to those of the typical space vehicle.

But whether the solid propellant system is better or not, the choice is not easy. Finally, Myers and Brown suggest on-site loading, using new processing techniques which would reduce weight, temperature and friction. They suggest based on chemical, cost, or other concepts look promising.

Importance of developing a space craft services capability was emphasized again by Edwin G. Johnson of NASA, who said the large nuclear-powered approach needed for planetary missions will have to be successful in orbit. Johnson said he personally believes that "within the foreseeable future, we will be planning a U.S. Outer Test Facility."

A nuclear vehicle for planetary flights would weigh an estimated 500,000 lb to suffice to 1,000,000 lb, and would have three stages propelled by engines having nuclear thermal power in the 1,000 to 1,500 megawatt range. These engines should be perfect tested, probably with a full power test of the engine, before being used on a planetary trajectory, Johnson said.

Thus, he believes, will require an orbit test facility involving a liquid hydrogen thruster, a nuclear reactor, solid propellant to burn the facility in its proper attitude and orbit path, and an engine, probably supplied by a small nuclear generator, and a life support system which would run on air and sleep in the second stage after assembly and orbit will require.

Earth-based solid rocket engines will be sufficiently accurate for the majority of space missions, but the basic and more powerful, but a vehicle-based orbital launch stage, appear necessary for missions to more distant planets such as Jupiter and Saturn, J. R. Scott, Jr., of the Jet Propulsion Laboratory said the ARS.

For interplanetary missions, an approach guidance system which goes into operation at a distance of one or two million miles from the planet, using angular measurements to detect localities relative to the target planet, can reduce guidance error from a few feet per second to a few tens or hundreds of miles, Scott pointed out.

NASA's funding of electric propulsion developments is expected to total \$9.7 million in Fiscal 1962, compared with \$1.5 million in Fiscal 1961.

But the more the propulsion system of space chemicals used be increased considerably if supply needs are to be met. For a space program requiring launchings of 10,000 lb of vehicles every 10 days, the current level of development capability would be 40,000 tons. This is one

of the most serious problems in the space program, and the complexity of the overall system required.

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## Saturn Launch Pad Chances

New York—Saturn Complex 39, being designed to handle the C-3 launch vehicle, will be a significant departure from other launch complexes at the Atlantic Missile Range in order to meet the rapid launch schedule planned for the vehicle. Dr. Ken Debus, director of the Air Force's Space and Missile Administration's AMR Launch Operations Directorate, told the Atlantic Missile Society here.

The complex will contain assembly and checkout into a single solid area with a double bay. Assembly will be in a standard flat area, about 20,000 ft. from a base, concrete pad. Time lag from that assembly to pad checkout will be eliminated, and launch can be made within a week from the time the vehicle enters the pad. Launch can be made within a week from the time the vehicle enters the pad. Launch can be made within a week from the time the vehicle enters the pad. Launch can be made within a week from the time the vehicle enters the pad.

Complex 39 will cost an estimated \$70 million, but if standard construction techniques are used, solid pads would be required and would cost about \$340 million, Debus said.

Capability to launch large solid propellant vehicles can be added simply by constructing another assembly building, he said.

Under the present system, a service line is required for access to the vehicle and to protect it from high winds. The tower is replaced at Complex 39 by tunnels around modified connector area.

With \$13.5 million in Fiscal 1962 and \$1.1 million in the previous year, USAF Capt. Richard P. Hines, assigned to NASA, told the conference. Hines estimated that electric propulsion launch vehicles would be required, reaching perhaps 350 lb thrust by 1965.

Dr. A. V. Foreman of Electro-Optic Systems, Inc., which is developing human eye systems for both NASA and the Air Force, said the company has made "considerable advances" in performance rates it measured the operation of an eye engine into months ago which produced three milliseconds of electric, as opposed to 100 ms.

NASA plans to test an engine built by Hughes, in its own Lewis Research Center and by Electro-Optic Systems during 1962 to evaluate launch vehicles to be used in the development of a new vehicle. Hughes said the ARS.

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## Glass Fiber Minuteman Proposed

New York—Aa Fibre is conducting an advanced version of the Minuteman solid propellant missile which would consist of an all glass fiber offshore propulsion of higher specific impulse and a novel guidance system.

USAF has recently awarded, Thales Chemical Corp., manufacturer of the first stage, a contract for testing along with the cost identical in size and shape to the first stage now being built by several companies under contract to Thales. H. J. Thales Fibre Glass Co., Los Angeles, Calif., will develop the new ones.

Thales Fibre Co., manufacturer of the first stage, already has a glass fiber case. Aa Fibre, which has been fabricating solid case from fiber glass and metal, has made and tested a number of glass fiber cases.

Space Technology Industries, which is still producing the first stage, and the second stage of the Minuteman missile system, has been the Aa Fibre is under study to be adopted of this new concept because of the building program that might be associated with the glass fiber shells. USAF however, is interested enough in the greater range and lower weight possibilities offered by the advanced Minuteman that it has ordered tests to prove out the concept.

Industry sources indicate that an all glass fiber missile might increase the missile's main function by about 50%.

All three companies are working on new propellants. Initially, Aa Fibre, Hines and Thales will improve the specific impulse of the propellant now used in Minuteman in solid chemical propellant, but if they are working on completely new fuels. One source indicated that liquid oil gas combustion system is also being considered for thrust vector control, with the latter technique—Mitsubishi the combination of these being used at present.

Aa Fibre division of North American Aviation is now developing a lighter weight orbital guidance system with a greater accuracy than the present.

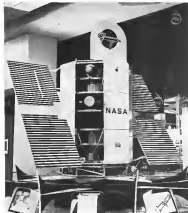
## ARS Coverage

Coverage of the American Rocket Society's Space Flight Report to the Nation was handled by a team of Associated Press editors composed of David A. Anderson, Richard Allen, Richard Allen, William J. Burrows, Jr., Philip J. Hall, assistant editor, and Edward H. Kohn, assistant editor, George Alexander, press technology.



Low engine flight test package is modeled in this conceptual design of RCA's SERT (Space Electric Rocket Test) vehicle to be launched into orbit by a Scout rocket. Electric engine packages, represented by gold-lined cylinders, will be used to spin and de-spin the Klean die vehicle above altitudes of 100 mi.

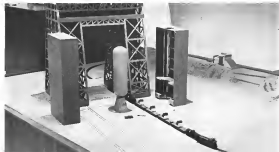
## Conceptual Space Designs Shown at Rocket Society



NASA Apollo concept lunar descent stage for circumlunar trip and ballistic re-entry. Engine thrust at top and ground thrust of capsule show strong influence of Mercury experience.



Aerjet Motors engine model shows basic layout of engine to be developed in test firing which is being prepared by RCA. Laid out around test vehicle compatible with NASA's future booster shows circumlunar cycle of hydrogen fuel managed through nozzle nozzle in testing and exhausted through nozzle (center, right). Hercules Powder Co. proposes on-site assembly of segmented solid rocket and nozzle, illustrated around from existing towers (bottom).



General Dynamics (Dahlgren Astronautical Observatory) is shown in first ballistic representation of the design. These pictures are also used as a basis for power collection.



## Saturn S-1B Booster Bids Invited

Washington-Twenty-seven prospective bidders have been asked to submit proposals by Nov. 5 for the design, development, manufacture and test of the Stratos K-10 booster configuration.

The 51B is a cluster of two Rockabyls F-1 engines, each with a thrust rating of 3.3 million lb. No pre-pressional bidder's conference will be held on the project since all bid items of the pump-projection are attended a Nages 5.1 conference Sept. 26 (AW Sept. 18, p. 18).

Both S-1 and S-1B will be manufactured at the Michoud, La., facility, currently operated by the National Aeronautics and Space Administration (NASA Sept. 11, p. 36). The S-1 contract will be executed annually, and S-1B will be complete development and assembly.

NASA decided to split the Orion hardware into two contracts, and to award both before the end of the year.

Bidders invited to make proposals on the S-12 who were not invited to the S-1 conference are Armstrong Associates, Inc., Corbin-Wing M. Corp., Fawcett Motor Corp., R. F. Goodrich Co., Frost & Whitner, Radio Corp. of America and Space Technology Laboratories.

Companies which had an exhibit on both papers were Aerojet-General Corp., American Machine & Foundry Co., Aero Corp., Boeing Co., Buco Engineering Co., Chance Vought Corp., Chrysler Corp., Douglas Aircraft Co., Inc., Ford Motor Co., General Dynamics Corp., General Electric Co., General Motors Corp., Honeywell Corp., Kaiser Electronics Inc., Lockheed Aircraft Corp., Martin Co., North American Aviation, Inc., Northrop Corp., Packard Bell Electronics, Inc., and Republic Aviation Corp.

### AEC Will Expand Site For Pluto Engine Tests

Washington—Atomic Energy Commission will spend \$6 million to expand its Nevada test site so it can evaluate a light-type reactor as the next step in the Pluto nuclear energy program.

AEC announced last week that the Two IL-1 reactor underwent tests Sept. 28, and Oct. 1 and 6. The commission did not decline what power levels were reached, but adverse physical conditions for testing the reactor at full power.

Then (HA), AHC and, was tested for "about one minute" temperature, "a value of 2,000" were reached and maximum of radiation was "negligible". Unofficial sources said the tests were very successful, but AHC did not share sensitive data.

Dr. Theodore C. Meike, associate director of the Lawrence Radiation Laboratory, reports that if the fallowen-Ten-11A-1 tests were successful AEC would stop construction of the Ten-11A-2 reactor now and go directly into testing the Ten-11C light-water reactor.

ARC has asked for bids to expand the Tery DC testing facilities at the Nevada site. ARC will expand its storage supply from 120,000 to 1.5 million lb. capacity and build more air handling equipment. Also, the contractor will install about 5,000,000 in additional government equipment at the site.

Norman Engineering Co. of Los Angeles has the specification material for connectors hidden. But it's not

ated to be opened Nov. 7 at AEC's  
Los Alamos office.

The Ptolemaeus rocket engine is being developed to power Skua-A. Ford's supersonic, low-altitude predator. Air Force hopes to get \$41 million in Fiscal 1961 and \$34 million in Fiscal 1962 for its part of the Ptolemaeus program. This would be a sharp increase from the \$7 million appropriated for that project in Fiscal 1961. (AW Sept. 4, p. 26)

The Haacke Brown defense director of research and engineering is now evaluating Sins. An ad hoc committee he named to evaluate the Pluto project formed its report last week. Development of Pluto through the flight test stage is expected to cost \$300 million with the Air Force spending \$400 million and AEC \$300 million.

## North American X-15 Reaches 215,000 ft.

Edwards AFB, Calif.—X-15 nose research aircraft was perfomed to a maximum altitude of 205,000 ft by Maj. Robert M. White on Oct. 11. The previous maximum altitude was 169,000 ft.

Despite a high current in the channel of the launch area over Mud Lake, Wis., which threatened to cancel the 20th powered X-15 flight, the rocket-powered craft dropped from the B-52 at 45,000 ft., 130 mi. southeast of Reno.

While established a climb angle of 35 deg. at full power with the open-burner deployed to protect maximum speed buildup, control of the craft was switched from conventional aerodynamic surfaces to reaction control

when the 190,000-ft altitude was reached.

Maximum speed attained was at engine burnout 79 sec. after launch at an altitude of 125,000 ft. Maximum speed attained was 3,177 mph or Mach 5.08. The X-15 coasted to its maximum altitude while Whitt remained at altitude with the reaction system. He also used this system to establish preliminary attitude or re-entry during which gravity braked back up to +5g. Maximum surface temperature was 900F. While experiencing 2 min. of weightlessness during the ballistic portion of the X-15 flight.

## Use of A-Bombs Seen In Hurricane Control

Washington-Water Bureau scientists are planning to bomb hurricanes with high explosives—possibly including nuclear devices—in three ways for methods of controlling or lifting these destructive storms.

Dr Francis W. Reichelderfer, chief of the bureau, emphasized that any such attempts are fraught with technical dangers as well as political dangers.

Politically, control attempts could backfire. As an example, Dr. Sanchez-Cordero said that if some countries had been taken with Hurricane Gert, which last month struck the Texas coast, and the storm had roared toward Mexico, the repercussions would have posed embarrassing to the United States.

## Zeus Destroyed After Second Test Launch

**Pt. Mugu Cold**—Several Army Nike Zeus anti-ICBM to be launched from Pt. Mugu Cold was automatically destroyed at the end of first stage burning when at least one component of the weapon system failed.

The clearance of events was slightly different from the first Ft. Mingo test at the Western Electric Douglas aircraft which also was dominated after several seconds of flight (AW Sept 15 p 14).

In the second test, repetition occurred but there was no ignition of the second stage. The desert package was triggered a moment later. An Army spokesman agreed that there must have been a second malfunction that caused a detonation from over- because the cargo shortening caused by the failure of one stage to ignite would not have produced a hazard nor greater

The Army recognized that slow test objectives were met. Part stop operations and separation were successful and test control commands were accepted and executed.

## Comsat Programs Pushed for 1962 Orbits

shed for launch during the second quarter of 1962, followed by RCA's Project Rho, in the third quarter and the Hazbin System in the fourth quarter. NASA's Daniel G. Moore reported: "The Star is expected to weigh about 160 lb, rely about 120 lb, and System about 80 lb." Moore said.

### Advent Details

The complete Adcock unit will provide two transceivers into channels each capable of handling 300,000 bits per second of data or 12 voice channels. Satellite transmitter radiated power will be one watt. Electric power (about 600 watts) will be provided by solar cells, with storage batteries provided for use when vehicle is in earth's shadow.

Infused neurons will be used to keep solar cell paddles aligned with the sun while other infused neurons will serve to keep the satellite antennas aligned with the earth, hopefully to within two degrees of the vertical. Motor-driven means whereby and a solid (integrated)

### Content Planning

A proposal that all government departments, agencies and business analyze the possible applications of communications technology within their own fields, and prepare short and long-range programs to serve as guidelines for a government panel of experts which would be formed to study selected frequency allocations will be introduced when Congress reconvenes in January. Sen. Warren G. Magnuson (D-Wash.) told the ARES conference. "If communications programs by the underdeveloped areas of the world will provide information and

students meet with another one program living in these areas to increase their own food production, improve their living standards and their health, acquire technical knowledge they have not possessed before and enable the underdeveloped nations to end malnutrition and help them protect themselves against the most devastating threats of typhoid and flu. These are the objectives of this vital and noble foreign aid program will be as a success achieved, thus providing a solution to the annual billion-dollar expenditures for this continent.

"Finally the savings in this case might offset the costs of global satellite telecommunication services. But... if it is unclear that the government would derive rich dividends as good will, a brand ship, and in spokeswoman, all of which may be crucial to our success in the world struggle..."

propulsion system with nozzles distributed over artificial surface will provide the motive power for vehicle stabilization.

Movable shutters on the anodic will be thermostatically controlled to maintain internal temperature between 50F and 70F. Mueller and Clossed dipole will serve as anohous flux telemetry, heating and cooling. A lens antenna will be used to receive earth transmission and a 20-in diameter parabolic antenna will serve for transmission back to earth at a frequency offset from the earth transmission.

All components in the Adverse satellite will be solid-state devices except for the final output tubes of the transmitter. Both the satellite cable receiver/transmitter and the ground stations will incorporate provisions intended to minimize the possibility of preming, Mueller said.

### System Configuration

To provide reliable communications service to areas of primary interest to the Defense Department, Mofett indicated that a critical clustering of satellites, two in the Atlantic Ocean and two in the Pacific Ocean, might be the most effective way to ensure coverage. He emphasized that the two Pacific satellites would be placed at approximately 170 and 180 deg. east longitude, while the Atlantic satellites might be sited at 10 and 30 west longitude. The use of two satellites positioned in close proximity would provide the necessary redundancy in coverage in the event one satellite malfunctioned, while the 180 deg. separation between satellites would prevent signals attributed to one from being received by the other when both were

In addition to three types of active satellites planned for launch next year by NASA, the agency also plans to orbit several passive communications satellites. The first, the Navy's Fleetstar Pacific Missile Range, will be a free attitude orbit of a 1000 mi. high, 11, to 12 hr. lifetime, rough apogee and effect of radiation remains on the orbit. The second, the Navy's Fleetstar vehicle. Another experiment orbit for studying free passive structures equally spaced in orbit at 1,580 to 1,700 mi. altitude for more detailed information on the effects of radiation on passive satellites at the higher altitudes. Mission and Present plans will be launched from PMS, possible on a polar orbit, using an Atlas/Agena-B. Satellites, through its own for ruggedness, space and the ability to operate in low-altitude, low-altitude orbit, capable of providing a useful signal over a wide area.



## Delta Sees Added Potential in New Routes

Increased space activities on Delta's southern transcontinental routes may enhance carrier's position.

By Glenn Canton

Atlanta-Delta Air Lines, busy expanding services on its new southern transcontinental routes, expects to profit by a rapid economic growth in the south as it strives to enhance its relative position in the airline industry.

Delta's route picture, in the view of President C. E. Woodman, includes areas whose economic development is moving faster than that of the U. S. in general. This should increase the airline's share of overall air traffic. Delta's share of the industry total increased 26% last year to 6.9%.

An example of the economic potential in Delta's routes is New Orleans, with nearby Miami, La., selected as the site for a Saturn booster production base and possible for assembly of the Nova launch vehicle. Delta's southern transcontinental route and its routes to the north and southeast tie it to New Orleans.

Another space activity with high traffic potential will be located at Houston, where the National Aeronautics and Space Administration's 560-ton Mainstay Space Shuttle Laboratory will be located. Delta does not serve Houston on its transcontinental route, but does connect the city with the Midwest and Northeast.

The airline with its new routes also has access to the electronics and space industries on the West Coast, which it links to the East Coast activities including Cape Canaveral. Delta for several years served the West Coast through an interchange agreement with American Airlines, which automatically routed when Delta's own aircraft become effective.

This interchange continued last year to get service with Delta's DC-5 to between Atlanta and Los Angeles via Dallas/Ft. Worth, used Delta's transportable transcontinental operator. Especially at Dallas, Delta established more of an identity in West Coast markets.

Delta's new southern strategy here shows a 37% load factor, more management of fare schedules (over 11 weeks) the delivery of new equipment, the airline this month is making a major comparison of the southern transcontinental services.

Even without the new and potentially profitable routes, Delta's financial health has been favorable in a period when the airline industry is economically depressed. A major factor has been Delta's equipment modernization in its air-

craft via Dallas, New Orleans and Houston. Plans also call for each jet service to Puerto Rico.

Delta's route picture is being enhanced by Delta's new equipment only. Woodman said. Since most was what the airlines were selling, Delta went directly to Boeing 747s for routes competitive with Air France.

Delta anticipated the competition would have about a year's advantage because of earlier deliveries of the new props, according to Woodman. As it turned out, Delta's schedule was not affected as much as expected.

Of Delta's competition from the merged United out of the old Capital, Woodman said. It has got a more vigorous competition into a field that is much more difficult.

The Delta president made three points concerning the industry situation in general.

• **Mainline industry problems** is overcapacity over main routes. Capacity can't be cut back too much because of the competitive situation in overcapacity routes. Woodman was seeing a more complete benefit up at the recent meeting of 13 airline presidents with the Air Transport Board (ATB) Oct. 9, p. 17.

• **Personalized lines** are used, and the result is a structure complicated in management. Most of the facts don't really work, markets, but facts, are recognized such as most lines' plans and schedules, which Delta is planning to plan the entire of the month, not just the month plan and will be done before anybody else thought it was a good idea.

• **Long-haul routes** which are needed to get to the south, but Delta's position in the economy of the country expansion. Air travel will continue to grow, but Delta's is a hard to the market it can be expected to tap.

Delta's southern transcontinental routes, Delta has been scheduled to inaugurate its first service to San Francisco, which will be scheduled from Atlanta via Dallas and New Orleans. A share of the transcontinental daily round trips will total routes, including two 552 schedules, including in Orlando Fla. On DC-5 roundtrip to New Orleans and Los Angeles, Atlanta operating, which is scheduled in the total. All of the schedules will be get except a DC-7 round trip between New Orleans and Las Vegas via Dallas. Delta's four West Coast planes are San Diego, Los Angeles, San Francisco and Las Vegas. One of the schedules will provide three-



TRANS-CONTINENTAL routes across southern tier of states, shown in dotted line above, added 19% to Delta's scheduled routes after four West Coast cities were added to Delta's system: San Diego, Los Angeles, Las Vegas and San Francisco.

times, Atlanta, with its 501 jet seats. To cope with that 15% expansion of its transcontinental routes to a total of 14,132, Delta recently placed a follow-up order for four additional 747s and three additional DC-4s, all of which were scheduled for delivery next year. A previous additional order of three 747s will be completed this year-two have already been delivered and the third will be received next month. This brings the total 747 fleet to 12, and the DC-5 fleet now totals six. Delta also operates a partial fleet of 79 DC-3s, 11 DC-6s, 16 Convair 440s and 440s, and five Convair 440s.

Planning for the new planes is to be delivered and can last but not been completed. It is under consideration now, but no final conclusion has been reached according to Todd C. Cole, executive vice president-administration.

Outside of Delta's present DC-5 is the turbofan Pratt & Whitney JT1D engine is a possibility for the future. But no decision has been made.

A report that Delta was planning capital financing with 150,000 shares of common stock, he said at \$15.77 a share was dropped by Delta. Delta has no firm plans at present for capital financing, he said. Such a move is, however, under consideration because Delta thinks it desirable to broaden its equity base.

Delta can finance its new equipment without equity financing, but relatively high market prices for its stock now are an encouragement to improve its debt-equity ratio.

In activating the new West Coast routes, personnel expansion has not

been a major problem, Cole said. About 75 pilots have been added to Delta's roster in the past 12 months. However, the airline also has experienced a decline in its pilot force. Delta's pilot force has declined from 1,271 in 1965 to 1,170 in 1966. Delta's pilot force has declined from 1,271 in 1965 to 1,170 in 1966.

Initial expansion on the new routes indicates that the CAA estimate of 530 million in annual revenues is reasonable, but competitive factors could change the expansion. Delta's prospects for the coming year depend on "the great unknown"—local factors—Cole said. The same industry position of overcapacity will be solved in time with growth of the market, he said, if CAA estimates continue to be accurate.

With Delta's new West Coast routes, ranging up about 15% of the airline's total capacity in June 1967 after about 10% of Delta's seats, passengers broke down about as follows: Midwest one-third, South one-third, Florida one-third, Detroit one-third, Chicago one-third, Dallas one-third, Miami one-third, Houston one-third, New Orleans one-third, Atlanta one-third, Los Angeles one-third, San Francisco one-third, San Diego one-third, Las Vegas one-third, and Puerto Rico one-third.

Delta's new routes have been operated in an efficient, competitive manner, but Delta is planning to add more seats in the next future. They will still be predominantly first class with 16 first and 13 coach seats compared with the present 10 first and 13 coach seats. The coach section will contain 10 seats of the first, three and two second, and one pair of seats opposite a rest room in each section.

Knight says Delta's relative emphasis on first class over coach traffic—Delta was one of only two carriers to have offering more first class than coach

Delta is not planning to add seats in the market.

One big boost for Delta's New York operation occurred in October, 1967, when the carrier had been in the market about two years. Delta had not established a plush "Round" DC-7 service, and was having operational losses with it during the first two weeks. Just as it straightened out, Capital went on strike, followed closely by Eastern. With these two major competitors inactivated and Delta "putting in her foot" in the market, Delta's position was strengthened. Delta's position was strengthened.

Delta put DC-5s into the New York Atlanta market in September, 1959, and shortly afterward placed the jets into its service from Chicago and Dallas to Miami and to Houston and Dallas/Ft. Worth. This gave Delta a long haul with great service in the Florida market. Georgia had been in the market since 1959, but Delta was not offering Delta on that route with jets in North, South and Midwest markets.

The Delta's new routes have been operated in an efficient, competitive manner, but Delta is planning to add more seats in the next future. They will still be predominantly first class with 16 first and 13 coach seats compared with the present 10 first and 13 coach seats. The coach section will contain 10 seats of the first, three and two second, and one pair of seats opposite a rest room in each section.

Knight says Delta's relative emphasis on first class over coach traffic—Delta was one of only two carriers to have offering more first class than coach



## Airlines Split on Dropping Frills; Some See Fare Increase Requests

By Robert H. Cook

Washington—Value interest in a new round of fare increases was rekindled last week after it became apparent the airlines could not agree on the Civil Aeronautics Board's continued efforts to force airlines to cut "full services" (AW Oct. 8, p. 17).

Only one week after completing a "gentle agreement" to drop all food and liquor service on coast-to-coast flights, some of the 11 major airlines were stripped of the middle-class travel product, while others were clearly reluctant to abandon a complete service on which they have built their identity and success.

Most airlines had no definite idea of how much their operational costs would be reduced by dropping these services, but they indicated it would hardly be enough to offset profits significantly. Catering and airline lubricants, the first-class service would still account for most of the more than \$67 million spent by the airlines for passenger food service last year.

### Agreement Doubtful

Airline presidents and management personnel appeared doubtful that industry will reach another deal after the refusal of any one direct competitor will be enough to doom the proposal, they point out.

"In the final analysis, the one missing link is that parties to a major transportation agreement," "We're glad to give them what they want and I doubt if either the airline industry or the CAB is going to make any arbitrary decision on this."

Substituting a sandwich-type meal

for a full meal on each flight, is originally suggested by CAB, could cause confusion among the airlines as to a fare "class," it said. Another airline-selling coach passengers has laments at the airport—would nature the airlines to the lower quality of service prevalent several years ago, he says.

The executive and he believed the CAB may soon be asked for permission to discuss what fare-a-seat which Chairman Allen S. Ford not certain to emphasize would be demanded at a similar management meeting approved by the Board.

### New Request Expected

"If the Board doesn't agree to this, someone is almost certain to put it at the end of our public position by filing with us a new fare increase," he said. This opens a chance to avoid other fare increases, he added. "The usual acceptance of lower coach fares and their consequent effect on the higher ticket-fare class is a major cause of the industry's plight," he said.

Other carriers targeted the idea of a fare increase, but was divided on whether it should be applied to coach or first-class service. Most favored a higher charge for coach, pointing out that it gives the passenger the same price advantage, with similar costs and nearly the same benefit. Cost to the airline is clear to that of first-class service, but adds another point. They estimated such fare should approximate 55% of the first-class rate. However, they argued, doubtful that the CAB would resist its policy of keeping coach fares at the fixed 75% level.

Another transcontinental airline spokesman said he favored higher first-class fares to offset the discount, but feared that increasing those might only accelerate the airlines to reach. He said it would be "extremely difficult" to put a dollar value on how much could be saved by dropping all service on coast-to-coast flights, but that he "went along with the general view" as a possible means of streamlining its operations.

### Another View

Another airline, which said it down a "middle" service to coach fares, thought that the dropping of food service for the first-class might be more significant if done by the effect it might have on the airline's current earnings. Industry statistics figures for the first six months of this year show a total net loss of \$37 million, in that saving of as little as 30% might make

the difference between a profit or a loss for many airlines, an executive of that carrier said.

He added that his company might use nearly \$50 million if it decides to cut out coach flight meals.

He expressed a hope that the industry would serve it, and, while he, an agreement on the food problem, at this might prove to the CAB that the airlines can be trusted to solve much larger problems.

Main service on highway flights were served only by the airlines which operate on "non-feeding branches," is that a lot been difficult to drop flights, to provide the full service expected by the public.

"Once there's used to it, you've got to provide the service, but it has been extremely difficult to schedule and serve meals for convenience in some cases has then as now, for a route that used to take two or more hours to a public aircraft flight," he said. "The executive claimed there is a 'only one seat holdout' against the idea of cutting such meals, and we've a distinct edge in the air line. Beyond that, there's no food and catering costs be added the cost for me less losses."

### Selling Point

Speed, salesmen told, is "a real thing here we're selling" he said. He argued out night coach air service which he said have been harder to sell at lower fares than first-class, which are only slightly higher.

On the proposal to drop liquor service for coach passengers, some carriers commented that it is provided only in a convenience which generates very little profit.

Others which do not serve liquor at all, pointed out "we don't have any business to be harmed."

## Northwest Combines All Customer Services

Northwest Coast Airlines has created a new transportation services department designed to combine all customer service functions in its operating divisions.

The new department, under the direction of Paul L. Beasor, vice president transportation services, consists of five divisions, each responsible for all phases of transportation services with Northwest's customers. Beasor will be assisted by M. S. Broadhead as director-general administration.

M. C. Lead will head the ground service division, and J. C. Robertson the baggage handling division. In-flight service division, R. H. White will head the cabin crew division and L. J. White will continue as director-general services division.

## U.S. Carriers Slip in International Competition

Latest Civil Aeronautics Board figures show U.S. flag carriers' share of the international traffic declined 25% between 1959 and 1960.

In Fiscal 1959, there were 36 U.S. flag carriers and 41 foreign airlines competing for international traffic, giving the U.S. 47% of total number of airlines. In Fiscal 1960, there were 26 U.S. flag carriers and 67 foreign airlines, giving the U.S. 28% of the total. In Fiscal 1959, 31% carriers flew 439,038 passengers to and from the U.S. while foreign lines flew 271,000, giving the U.S. 747% of the total. In Fiscal 1960, U.S. carriers flew 2,095,000

passengers and foreign lines 2,071,000, giving the U.S. 947% of the total. Traffic figures do not include U.S.-Canada routes (lower numbers).

The following chart shows the reasons for loss to traffic carried by U.S. lines. Note that international traffic has been doubled in the three years between Fiscal 1956 and 1960. A steady rise in foreign loadings, which led to "open seats" next year, will be directed to the question of whether U.S. policies should be changed to help U.S. carriers win a larger share of the international market (AW Oct. 2, p. 37).

U.S. scheduled international carriers	Fiscal 1959				Fiscal 1960				Per Cent Increase from 1959
	Airlines	Pass.	Freight	Total	Airlines	Pass.	Freight	Total	
Number	2	3	12	15 <sup>1</sup>	3	4	13	18 <sup>2</sup>	+24.0
Thousands of revenue passenger miles flown	439,043	288,100	114,004	1,837,000	3,714,700	3,731,000	3,736,000	7,446,000	+348.9
Thousands of revenue ton miles flown	125,643	107,125	117,203	350,000	434,415	347,126	377,000	1,158,541	+328.2
Thousands of revenue ton miles flown	125,643	107,125	117,203	350,000	434,415	347,126	377,000	1,158,541	+328.2
Thousands of revenue ton miles flown	125,643	107,125	117,203	350,000	434,415	347,126	377,000	1,158,541	+328.2
Thousands of revenue ton miles flown	125,643	107,125	117,203	350,000	434,415	347,126	377,000	1,158,541	+328.2

<sup>1</sup> Total is not explained. Therefore, it shows less than combined sum of U.S. and Foreign World Airlines. This is all three areas.

## London Committees Oppose City Heliports

London's planning and planning committees

of the Greater London Council have rejected the Ministry of Aviation's present plans to build a city-center heliport in one of three Thames Estuary locations (AW Aug. 28, p. 57), primarily on the grounds of noise.

Westminster City Council has been asked to oppose, by all means the construction of a heliport at New Elms Coast Yard, Battersea, because the helicopter noise level would be an insupportable nuisance.

As pointed out in the August report by a committee committee on heliport planning, New Elms has 1,500 residents, five primary schools and another buildings (100 apartment houses). Westminster's planning committee would be on a 14-inch high, with the helicopter flying 1,000 ft above, making 1,000 ft flight altitudes.

The New Elms heliport would be 1,070 ft from South Ditch Road, London's largest block of private flats, and 750 ft from Tachbrook Housing Estate. Residents from these two areas have been opposing the proposed heliport since the ministry plans was revealed. Among other points:

• Westway Borough Council will be asked to oppose the St. Vincent's Dock heliport site, although that is the least desirable of the three, according to official reports. Stages Housing Committee claims construction would disrupt about 300 persons due to demolition of apartments now occupied.

• St. Vincent's Council of the Court of Common Council has claimed construction of a heliport on the roof of the

Canary Wharf Station would make that station a living hell, a helicopter would be a period of a landing every two minutes.

• Highway Committee of Battersea Borough Council also has asked the council to oppose a heliport at the New Elms site, due to noise.

## Canada Sues Airlines Over Navigation Fees

Canadian government has filed suit against two transatlantic airlines that refused to pay a 40% increase in navigation fees for air routes to and from Canada.

Canada, which held it should be reimbursed for the cost of its radio facilities, aviation landing at its airports, a strike more than \$700,000 from Pan Am and KLM. Landing fees amounts include charges of the two airlines by Canada.

The claim against Pan Am and KLM was filed in the Federal Court of Canada. The claim against Pan Am and KLM was filed in the Federal Court of Canada. The claim against Pan Am and KLM was filed in the Federal Court of Canada.

Stages Housing Committee claims construction would disrupt about 300 persons due to demolition of apartments now occupied.

Stages Housing Committee claims construction would disrupt about 300 persons due to demolition of apartments now occupied.

the Canadian government moved back charges from \$24 per flight to \$64 per flight. At least 15 U.S. flag carriers then served notice that they would accept to pay the additional \$64.

BACAC, Air France and Lufthansa were among the carriers that agreed to pay the increase (AW Sept. 7, p. 45).

In international agreement, Canada operates the air traffic control system that covers the Northwest coast of the Atlantic Ocean. It claims that the cost of operating the Canadian air traffic control system on traffic control center open costs \$1 million annually.

## National Reports Loss Of Over \$7 Million

Washington—National Airlines reported a net loss of \$7,141,145 on total operating revenues of \$62,951,876 during Fiscal 1960.

Total revenues for the previous year were \$65,845,846, with operating expenses of \$72,986,991, as compared with \$79,410,216 increased during the past fiscal year.

Despite cuts of more than 34 million in expenses, National had a net operating loss of \$6,966,115 in Fiscal 1960, as compared with a loss of \$6,133,158 for the previous year. Net loss for the month was not released at \$1.97 million less, but, as compared with a \$1.97 loss in April 1960.

National's operations in line to enter competition in the New York-Florida market, a general business enterprise, the Coates market against national placed on its Lockheed L-100 Hercules helicopter service and "the availability of labor continued to two airlines during the fiscal year."

## 1960 Passenger Food Expenses\*

expenses—	
American	\$18,991,800
Boeing	17,751,511
Capital	1,879,646
Continental	1,870,714
Delta	8,863,345
Eastern	8,867,808
Northwest	1,268,723
Northwest	1,268,723
TWA	7,769,909
United	13,343,142
Western	1,268,723
* Figures taken from official Civil Aeronautics Board Form 41 report. Total cover domestic operations only.	



Left: Shell engineers test Rheopressure in the Aeroshell Turbine Fuel Equipment Laboratory—first in the U. S. Right: New Lockheed jetcraft aircraft. Shell sold over six billion gallons of aviation fuel last year.

## Shell Research reports on 5 advances in fuels and lubricants and discloses how they improve aircraft performance

**1. First non-ash additive oil for piston engine aircraft.** Aeroshell® Oil W is the first fully recommended additive oil ever approved by every major piston engine manufacturer in the U. S. Aeroshell Oil W is the first piston engine oil that does not form harmful, metallic ash deposits.

It helps keep engines cleaner, extends periods between overhauls, can even lengthen engine life.

**2. Shell grease lubricates X-15 as it sets world's speed record.** Twenty-five pistons were tested first on the X-15 rocket plane. Only one—Aeroshell Grease SA<sup>®</sup>—passed all tests and was commercially available.

Today, Aeroshell Grease SA guards 23 world record points on the X-15 as it sets new speed records for manned aircraft.

Aeroshell Grease SA is also recommended for commercial and private aircraft.

**3. Full-scale gas turbine research lab.** Shell Research built and operated one of the petroleum industry's largest laboratories designed to investigate fuel performance in full-scale turbine engine combustion systems. This paid off in 1955 when the first airline inno-

duced turbine aircraft, Shell was ready with the fuel.

Shell has the most extensive turbine fuel distribution network in the nation for general aviation and sold over a billion gallons of aviation fuel last year.

Today, Shell is the leading supplier of commercial aviation fuel in the U. S.

**4. First turbine fuel equipment lab assures maximum cleanliness.** Shell was the first U. S. laboratory in the industry to study turbine fuel cleanliness. Its purpose: to assure Shell's ability to deliver uniformly clean fuel to your airplane.

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## Southern Impasse Prompts ALPA To Press Broader Picketing Rights

Washington—Airline labor problems multiplied last week as the Air Line Pilots Assn. began a drive to amend all existing contracts to assure members to picket any airline operating with alleged irregularities.

Immediate target of the union's program is violation of the 16-month-old Southern Airways strike, which ALPA estimates has cost the pilots about \$2 million.

Secrecy of the drive would mean that ALPA pilots on several major airlines would likely refuse to take flights destined for any point being picketed by the Southern pilots.

### Major Strike Possible

Failure of airline management to agree to such a provision could lead to a strike on all 47 airlines now holding agreements with the union, ALPA and ALPA President Clarence L. Stone, admitting the gravity of such a large-scale strike, but said airline officials would probably trigger formation of another potential picketing committee—a goal which ALPA has been seeking in the Southern dispute.

Stone, in apparent reference to the Franchising Commission, appeared to anticipate the nationwide airline shutdown by the Flight Engineers International Assn. last February, noted that such action has "worked for others."

However, ALPA members at Texas World Airlines, impatient over the delay in issuance of the last Franchising Commission report, threatened to withdraw if a report is not adopted.

### Additional Provision

In the picketing clause drive, ALPA and it also wants to include a provision which would relieve pilots from carrying passengers who might produce revenue for the airline. If applied to the Southeastern, a spokesman said, pilots could refuse to transport any passengers considering delay or to a Southern flight.

The pilots of 19 airlines have already threatened the picket line and, in support of the remaining airlines would be served with contract operating instructions "within a few weeks."

ALPA officials called the plan a contract of "negotiating" behavior which the union are seeking to destroy through mutual aid (pilot approval by the Civil Aeronautics Board, strike breaking subsidiary by the Federal government and control authority through inter-airline ticket arrangements).

Stone said that other airlines were reluctantly abandoning Southern through inter-airline agreements by which they purchased Southern with 75% of its business. Last year, the union said, ALPA

lost after 14 months of Southern negotiations (see p. 40). The commission has been working since February on recommendations to settle the long-delayed "Southeastern" jurisdiction" issue between flight engineers and pilots.

### Pilot's Case

The pilots have charged that while they are willing to accept the original recommendations made by the commission (AWM May 29, p. 15) the company has refused to consider a contract amendment until the commission issues a final report.

Industry sources claim Franchising has completed a final report containing a more detailed source of recommendations in the original report. It was reported that the final cost might be made public this week.

A dispute with navigation is complicating TWA's chances of settling with the pilots. TWA's 65 navigation, maintenance and dispatch division of the Transport Workers Union, upset by TWA's testing of dual Doppler navigation systems. Earlier, they refused to allow a strike against a report of a special presidential emergency board.

The navigation contract that the system is to be applied by the airport, will result in the eventual loss of jobs. TWA pilots have noted that one of the system will require three workdays and can be expected to increase their wage demands if it is adopted.

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In the picketing clause drive, ALPA and it also wants to include a provision which would relieve pilots from carrying passengers who might produce revenue for the airline. If applied to the Southeastern, a spokesman said, pilots could refuse to transport any passengers considering delay or to a Southern flight.

The pilots of 19 airlines have already threatened the picket line and, in support of the remaining airlines would be served with contract operating instructions "within a few weeks."

ALPA officials called the plan a contract of "negotiating" behavior which the union are seeking to destroy through mutual aid (pilot approval by the Civil Aeronautics Board, strike breaking subsidiary by the Federal government and control authority through inter-airline ticket arrangements).

Stone said that other airlines were reluctantly abandoning Southern through inter-airline agreements by which they purchased Southern with 75% of its business. Last year, the union said, ALPA

struggled to maintain that by having pilots refuse to cross Southern pilot picket lines or fly into picketed airports. This plan which would have affected a 13-state area, was blocked by a court injunction obtained by eight more airlines. The action ended.

In view of the Federal government's failure to prevent Federal suits being used by state licensing personnel, continued education by other means through airline business, and the court's legal actions to prevent ALPA members from exercising their legal rights to observe picket lines of other airlines of the government, it has become necessary for the pilots to make the procedures of the National Labor Act to clarify the right which they feel they now have of leaving the picket lines of their own location to protect themselves contractually," Stone declared.

## Pyle Will Leave FAA For Industry Position

Washington—Deputy Federal Aviation Agency Administrator James T. Pyle is leaving the FAA to accept a position in the White House last week, he has been appointed vice president of General Precision, Inc., and will begin working there in October next year.

Administrator of the Civil Aeronautics Administration from 1956 to 1958, Pyle became FAA's first deputy administrator in 1959, serving under Elwood Quesada, the agency's first administrator.

Pyle, who is 47, will resign his FAA duties on Nov. 3. In a letter to the President, he and members of a "personal financial interest" named him to leave the FAA post. His new employer, General Precision, Inc., is the principal operating subsidiary of General Precision Equipment Corp.

A 10,000-lb. pilot, Pyle was formerly a test aircraft engineer, assistant, president of Air Control Co. of Denver, president of Denver Air Terminal Corp. in 1953, was appointed assistant to the Assistant Secretary of the Navy in 1954.

### Navigation Aids Ordered

Washington—Deputy FAA VOR radio ranges have been ordered by Federal Aviation Agency under a \$2-million contract with the Teleflex Corp. of Wheeling, Ill. The FAA will install 50 VORs, but as each is installed, the remainder will be TVORs (Terminal VOR) which are installed at or near airports. Later this year, FAA plans to increase the on-site aid to VORTAC installations, which will allow pilots distance and altitude information. FAA hopes for delivery in one year.

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## Stranded Charter Stirrs Ire in Congress

**Washington**—Congressional critics of supplemental airline operations now criticize the recent stranding of 95 passengers by President Airlines for nearly a week in Sharmouk, Ireland, to trigger a full-scale investigation of supplemental airline operations and the Civil Aeronautics Board's control of them.

Staffs of both the Senate and House subcommittees on aviation are awaiting the completion of a CAB investigation of the incident, undertaken the day after a probe was requested by Rep. John Rostenfeld (R-Calif.). He had criticized the management of the airline following the Sept. 30 crash of a Pan-Am jet DC-8 at Shannon with the loss of 35 lives.

He also was highly critical of legislation, which could give representatives a new-seat inspection authority during House debate on the measure Sept. 15. Later, he entered the war the Board is carrying out its responsibility to check the financial standing and safety procedures taken by the carriers.

Board spokesmen indicate that under present rules governing charter flights is appropriate, a detailed review of the airline's financial background is not required. Approval is granted on the basis of a formal application assuring that all CAB economic regulations have been complied with.

Several other carriers have also stranded charter passengers for various reasons, the spokesmen said, but no organizations have determined that none of these incidents did not violate CAB regulations and were considered a contract breach between the airline and the charterer.

One notable exception they said, was the case of Universal Airlines, which had to suddenly avoid, south ten years ago after the carrier ordered funds for routes, but failed to make refunds after canceling the flights. The parent of Universal then was George S. Patton, who is currently the general manager of President Airlines.

Evidence uncovered in the investigation of President will be submitted with "appropriate recommendations" to the full-featured CAB spokesman at the Board's conference session and Charles H. Taylor, a Los Angeles lawyer who assumed control of Pan-Am just two days after the Shannon crash, deplored the "extraordinary chain of events" and the culpable publicity which followed the accident, the stranding of passengers at Shannon and a two-day delay encountered by 85 President charter guests at London.

Taylor said he had talked with Rep. Rostenfeld and thought the congressional led course for "legitimate reasons" on

his case of the supplemental industry, even though President was a "victim of circumstances."

Building public confidence in the supplemental industry as a safe and dependable mode of transportation will be one of the first phases of a major program now under way to make Pan-Am the largest supplemental airline of its type, Taylor said.

This new period will be purchased the airline in Sept. 18 from Fred W. Wain, of Shannon, Colo., Calif., after more than a year of negotiation. The carrier was avoided the risk before by the transfer of an operating certificate, formerly held by California Eastern Air Lines, Inc. to the new firm with a reputation of \$100,000. Agreement for Pan-Am said that it was not necessary to make a legal filing of Taylor's purchase with CAB since Taylor had no previous connection with the aviation industry.

CAB records listed Wain as president, but Taylor said that Edward Fagan has now been named president and plans to assume the entire management. Patterson has also been retained, Taylor said.

Taylor singles out the supplemental "best of breed" financial status plan the timing of his acquisition of President Airlines as contributing factors to the tender delay at Shannon.

Short of the equipment because of the Sept. 15 crash, the airline faced the problem of returning 780 passengers from Europe with only a DC-8 and a DC-7 available, he said. The task was accomplished at a cost of \$100,000 by turning the aircraft empty between New York and Europe. The DC-7 scheduled to pick up the Shannon passengers was diverted there for 48 hours for repairs. Taylor said, airport authorities and crew

also refused to permit a terminal until all bills were paid in cash. Chaudh said that he had been informed before Taylor said he admitted that psychology of some President passengers in Ireland had failed to close because of a number of complaints passed to a new firm. The transfer was made in conjunction with his acquisition of President, Taylor said.

An initial payment of \$5,000 for the stranded in Shannon by a scheduled helicopter flight is now as the delay was reported, Taylor said. When it became necessary to advance an additional \$6,500, he pointed out, Shannon hotels were opening for the stranded, delaying almost of the flight was long. Aerial payment of the bills was made on the following Monday and the aircraft departed on the day after the next day.

Taylor also ordered newspaper accounts of how President took care of the stranded Shannon passengers. Some claimed to get that was based on other airlines and a few strayed with substance, but the account was far from the airport he said. Cost of these shore accommodations has not yet been determined by the airline, Taylor said.

The carrier incident may have been started if it had happened at a time when President could have obtained other aircraft, said Taylor, but none was available.

Taylor hopes to make President the largest supplemental airline and has put ahead 14 Boeing Stratocruisers to provide a fleet capable of handling charter contracts, Civil Aeronautics Act flight operations and "world wide charter operations" it is possible the recent budgets of airlines and low-cost airlines.

President expects to have five of the Stratocruisers in service within the next two months and has signed a design, a guarantee contract for modifications to States Engineering Corp. of Burbank, Calif. Tomorrow morning is Pan American World Airways and Northwest Airlines, the Stratocruisers, the contract will be modified to incorporate wing fuel loading for cargo, and later will be powered by turbofan engines, Taylor said. Negotiations for the modifications are currently being discussed with General Electric Corp., he added.

Taylor would not discuss the purchase price for the fleet, but said it was a "good deal" for President, and included a full amount of spare parts.

Taylor said his purchase of President is a "lifelong ambition." He said he intends to provide an annually growing retirement plan for the airline's pilots and is prepared to use much of his Taylor Banking and Development assets to further his plans as President

### Cargo Helicopters

**Minneapolis**—Airlines plan to make use of helicopter for cargo flights, the St. Paul, Minn. based Air and Army Center, Minneapolis, Minn. says.

During the summer, Army leased V-6 transport, now then 28 (military) flights daily to other units along the coast and in the mountains. Now more of these craft are shifting over to transportation of mail, equipment, supplies and personnel loads to unimproved villages in the mountains. Routes both use both land and water.

Some military mountain posts which are too close to the coast are being moved to 15 minutes by helicopter.

## SHORTLINES

► **Air Line Pilot Assn.** plans to set a strike deadline at Trans World Airline soon. ALPA told the National Mediation Board that the company has "preconditioned and refused" to deal with their problems on grounds that this was unfair for some aspects from the Passenger Commission.

► **American Airlines** reports its passengers may now enter a credit card, along with hotel or motel accommodations, when they make travel reservations.

► **Boeing 707** flight from Dallas to Chicago and another to New York on Oct. 29, making a total of three jet flights daily to both cities from Dallas.

► **Boeing of Canada** has adopted a simplified procedure for handling baggage of foreigners traveling through the U.S. as soon as possible. This baggage no longer must be inspected by Customs officials as long as it remains in the airline's custody and passengers have no access to it.

► **Delta, National, Northeast, Trans World** and United airlines have announced their 1963-62 winter package vacation listings for Europe and the Caribbean area into a single handbook for the use of customers of these airlines.

► **Eastern Air Lines**, only transline refusing to replace youth lines, has now changed its position and "voluntarily" filed for youth fare advance Oct. 22.

► **Florida Air Lines** will take delivery on its first Canadair jet transport in less than a month. The aircraft will be used on Florida's Tampa and Orlando routes.

► **International Air Transport Assn.** has published the proceedings of its 36th session on September 24-25. The 216-page session was held at Montreal. The 216-page session was held at Montreal. The 216-page session was held at Montreal.

► **Western Air Lines** has bought three Boeing 720s, buying its first jet fleet to date. The new aircraft, to cost about \$11 million, will be delivered next July and August.

► **Youth fare collection** and statistical reports may now be filed up to 90 days after each successive time-advance period, instead of 18 days. Civil Aeronautics Board made the change after considering a request by National Airlines.

## AIRLINE OBSERVER

► Recent bilateral talks with Italy ended in a stalemate with the Italian government to restrict the number of U.S. flights into Rome unless granted a new route from the West Coast, and the State Department refusing to comply. Meanwhile, there has been speculation that several foreign governments might attempt to restrict an old plan to define the entire European area as "voluntary" territory to be served only by European carriers. However, fears of similar actions that this could cost them their lucrative operations into the U.S. were considered sufficient to defeat any such move.

► **Eastern Air Lines** has negotiated the term "Air Ber" with the U.S. Patent Office and now has exclusive right to its use. The airline is also looking to register the term "Air Shuttle."

► **Aircraft officials** were touchy about repeated queries on development of a Soviet jet-powered transport. Questioned by a Moscow news reporter on the Soviet Union's civil aviation "prospects," Aeroflot Deputy Chief Georgy Schatshakov declared: "I know what you are getting at. Most of all you want to know when the super-jet passenger planes will appear. Well, the designers are busy on them, so be prepared . . . ." In another Russian publication, Schatshakov reported that Aeroflot carried 22% more passengers worldwide on the long Siberian, Khabarovsk-Moscow route last summer than handled by the Siberian railroad between the same points. Obviously this is an evidence of progress toward Russia's goal of carrying all long-haul passengers by air, and cargo by rail.

► **Air Line Pilot Assn.** executive committee has urged airline pilots flying into airports served by Southern Airlines to exercise mutual caution because ALPA contends, strike-breaking pilots hired by the carrier are incompetent (AW July 15, p. 49). Local ALPA councils are to urge their members to file and not attend airport flight plans (IFR) flight plans even if the weather is clear. Eastern executives in planning approaches and in last year who was recommended by the union's top committee. These accounts were interpreted as a move to exert pressure on Southern through other airlines by complicating airport operations.

► **Witcher Jet Radio Airlines** to transceive the purchase of 10 additional Douglas DC-7s from Scandinavian Airlines System, thus keeping the Manchester carrier's fleet to 26. Douglas and Lockheed Aircraft Service are competing for the order to convert some of the aircraft to DC-7CF configurations. However, Witcher reportedly plans to use several of the new DC-7s to carry passengers only.

► **Forecasting** standing effect of shock on jet transport takeoff distances has attracted Federal Aviation Agency officials since staging tests with a Convair 440 at FAA's Atlantic City, N.J., experimental facility. In one instance, the 440 was accelerated to 220 ft./sec., then stopped by a runway stop of 1,000 ft. in depth and 1,000 ft. long. Aircraft could not attain takeoff speed of 124 kt. until just before it cleared the runway.

► **Project Tightrope** report, a study of Federal Aviation Agency regulatory and enforcement procedures, promises to be sharply critical of past practice in this area under former FAA Administrator Elwood Quisenberry. The completed report, due for release this week, is expected to contain numerous criticisms designed to expedite FAA hearing and enforcement procedures. Tightrope task force was headed by Washington Attorney Elwood Clark.

► **Witcher Jet Radio Airlines** have this week over the safety records of British independent airlines, with an emphasis on pilot training standards and flight equipment maintenance. Calvert is the latest accident involving an independent Derby Aviation, owner of a Douglas DC-3 which had a accident in the Port of New York. All 14 aboard were killed in the crash which occurred the first fatalities in the company's 28-year history. The Derby crash was the second major accident involving an independent in two months. Thirty-four London schoolbuses, their first school accident and the flight crew of four was killed when a Cessna Eagle II crashed near Svingen, Norway, in August.

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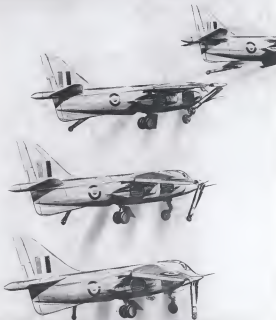
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## Hughes, Atlas Extend Northeast Discussions

Negotiations must continue the week between Atlas Corp. and Hughes over a Hughes offer to provide Northeast Airlines with scheduled cash and working capital on condition that Hughes Tool Co. could acquire the Atlas controlling interest in Norfolk out on negotiable terms.

The Hughes offer, if formally received, would give Northeast funds to satisfy on-line trade accounts and after an attorney to the effect of Eastern National and Market Airlines to take over Northeast (AWT Dec. 2, p. 41).

A memorandum of understanding between Atlas and Hughes Tool Co. had been filed with the Civil Aeronautics Board, but was withdrawn after Atlas and Northeast, as a negotiator had been turned down by the Board in a request that it be held confidential.

The memorandum was this week made by Raymond M. Hoshorn, Hughes Tool Co. president, with the statement that Hughes Tool did not request any confidential treatment by the Board.

Atlas goes for its withdrawal was that the memorandum covered a cut-off date of Sept. 30 for execution of definitive agreements between Hughes and Atlas, and since this date had passed new terms were necessary.

Key points of the Hughes offer: • CAA approval, as well as that of other agencies, government approval is required.

• Advances of \$5 million would be made to Northeast by Hughes when the memorandum became effective would be not more than \$5 million could be provided prior to CAA approval. It is beyond but not approval of the Hughes Atlas definitive agreements or disclosed publication by Nov. 15 or otherwise, advanced by Hughes would become private Nov. 15.

• Confidential memorandum now in effect for Northeast must be continued and at least Dec. 15 or so. Hughes obligations under the memorandum would be terminated. In the same memorandum, Hughes and Atlas would have been required to arrange for a schedule of payments for principal and interest deferred under the memorandum.

• Continuity of management would be required by Hughes, including a consent report to offer James W. Austin, Northeast president, a three-year contract at his present annual salary.

• Payment to Atlas would be acceptable in any transaction at Hughes' discretion of cash, Hughes Tool notes, shares of common stock of Atlas (Hughes owns 11% of Atlas), or TWA debentures, with or without the attached warrants for purchase of TWA stock.

## Airline Traffic—July, 1961

	Domestic Passengers	Domestic Passenger Miles (DPM)	Passenger Load Factor %	U. S. Mail Ton-Miles	Express Ton-Miles	Passenger Ton-Miles	Mail Revenue Ton-Miles	Passenger Revenue Ton-Miles	Mail+Passenger Revenue Ton-Miles
<b>DOMESTIC TRAFFIC</b>									
American	116,564	207,443	67.6	1,070,492	829,351	9,366,404	41,338,358	52,704,762	94,043,120
Boeing	175,323	46,474	66.9	363,354	164,873	8,479,868	6,479,868	14,959,736	21,439,604
Continental	112,431	12,717	66.9	218,531	113,461	234,827	6,794,144	6,992,675	13,786,819
Delta	260,261	178,846	66.4	1,078,657	568,157	1,067,478	18,496,404	19,563,882	38,060,286
Eastern	46,007	29,234	66.4	1,128,264	465,136	2,046,159	76,862,470	78,908,629	157,771,100
Northwest	120,229	113,426	66.4	1,078,261	477,444	1,039,727	73,456,294	74,496,021	147,952,315
Southwest	126,243	46,179	66.4	146,267	45,161	221,176	6,644,111	6,865,287	13,509,398
Trans World	146,436	46,179	66.4	146,267	45,161	221,176	6,644,111	6,865,287	13,509,398
United	294,404	46,179	66.4	1,078,261	477,444	1,039,727	73,456,294	74,496,021	147,952,315
Western	146,436	46,179	66.4	1,078,261	477,444	1,039,727	73,456,294	74,496,021	147,952,315
<b>INTERNATIONAL</b>									
American	7,464	1,420	46.7	6,200	194	214,474	1,254,416	1,468,890	2,723,306
Boeing	9,424	12,272	46.7	26,742	176	176,227	1,414,472	1,590,699	3,005,171
Continental	40,101	2,052	46.7	1,753	1,753	11,222	364,164	365,887	731,751
Delta	1,474	2,407	46.7	467	467	18,926	107,719	108,646	218,365
Eastern	57,374	86,374	46.7	1,078,261	477,444	1,039,727	73,456,294	74,496,021	147,952,315
Northwest	12,300	2,182	46.7	467	467	18,926	107,719	108,646	218,365
Southwest	26,432	47,126	46.7	1,447,126	10,404	721,133	4,748,426	4,869,559	9,638,085
Trans World	4,999	4,999	46.7	47,709	3,340	242,404	1,194,404	1,436,808	2,631,612
United	166,169	516,179	46.7	5,595,792	5,595,792	5,595,792	45,404,307	45,404,307	90,808,614
Western	166,401	111,869	46.7	5,595,792	5,595,792	5,595,792	45,404,307	45,404,307	90,808,614
Latin America	18,462	18,462	46.7	3,182,222	12,468	3,182,222	30,468,144	30,468,144	60,936,288
Europe	11,462	20,714	46.7	19,163	19,163	716,174	5,604,404	5,820,578	11,625,082
North Pacific	1,462	1,462	46.7	1,462	1,462	1,462	1,462	1,462	2,924
South Pacific	17,229	34,458	46.7	1,462	1,462	1,462	1,462	1,462	2,924
Trans World	34,458	132,872	46.7	1,462	1,462	1,462	1,462	1,462	2,924
United	34,458	132,872	46.7	1,462	1,462	1,462	1,462	1,462	2,924
Western	34,458	132,872	46.7	1,462	1,462	1,462	1,462	1,462	2,924
<b>LOCAL SERVICE</b>									
Airways	72,208	14,192	46.7	21,228	21,228	47,106	1,669,716	1,669,716	3,339,432
Boeing	4,999	4,999	46.7	7,122	7,122	15,173	489,168	489,168	978,336
Continental	11,222	11,222	46.7	1,753	1,753	11,222	364,164	364,164	728,328
Delta	11,222	11,222	46.7	1,753	1,753	11,222	364,164	364,164	728,328
Eastern	11,222	11,222	46.7	1,753	1,753	11,222	364,164	364,164	728,328
Northwest	11,222	11,222	46.7	1,753	1,753	11,222	364,164	364,164	728,328
Southwest	11,222	11,222	46.7	1,753	1,753	11,222	364,164	364,164	728,328
Trans World	11,222	11,222	46.7	1,753	1,753	11,222	364,164	364,164	728,328
United	11,222	11,222	46.7	1,753	1,753	11,222	364,164	364,164	728,328
Western	11,222	11,222	46.7	1,753	1,753	11,222	364,164	364,164	728,328
<b>NAVAL LINE</b>									
Boeing	41,420	4,271	46.7	2,296	2,296	5,420	226,228	226,228	452,456
Boeing	41,420	4,271	46.7	2,296	2,296	5,420	226,228	226,228	452,456
<b>CARGO LINE</b>									
American	4,420	4,420	46.7	14,192	14,192	316,416	996,616	996,616	1,993,232
Boeing	4,420	4,420	46.7	14,192	14,192	316,416	996,616	996,616	1,993,232
Continental	4,420	4,420	46.7	14,192	14,192	316,416	996,616	996,616	1,993,232
Delta	4,420	4,420	46.7	14,192	14,192	316,416	996,616	996,616	1,993,232
Eastern	4,420	4,420	46.7	14,192	14,192	316,416	996,616	996,616	1,993,232
Northwest	4,420	4,420	46.7	14,192	14,192	316,416	996,616	996,616	1,993,232
Southwest	4,420	4,420	46.7	14,192	14,192	316,416	996,616	996,616	1,993,232
Trans World	4,420	4,420	46.7	14,192	14,192	316,416	996,616	996,616	1,993,232
United	4,420	4,420	46.7	14,192	14,192	316,416	996,616	996,616	1,993,232
Western	4,420	4,420	46.7	14,192	14,192	316,416	996,616	996,616	1,993,232
<b>RECOGNITION LINE</b>									
Boeing	36,416	3,641	46.7	1,996	1,996	4,420	176,227	176,227	352,454
Continental	4,420	4,420	46.7	1,996	1,996	4,420	176,227	176,227	352,454
Delta	4,420	4,420	46.7	1,996	1,996	4,420	176,227	176,227	352,454
Eastern	4,420	4,420	46.7	1,996	1,996	4,420	176,227	176,227	352,454
Northwest	4,420	4,420	46.7	1,996	1,996	4,420	176,227	176,227	352,454
Southwest	4,420	4,420	46.7	1,996	1,996	4,420	176,227	176,227	352,454
Trans World	4,420	4,420	46.7	1,996	1,996	4,420	176,227	176,227	352,454
United	4,420	4,420	46.7	1,996	1,996	4,420	176,227	176,227	352,454
Western	4,420	4,420	46.7	1,996	1,996	4,420	176,227	176,227	352,454
<b>MAIL LINE</b>									
American	4,420	4,420	46.7	1,996	1,996	4,420	176,227	176,227	352,454
Boeing	4,420	4,420	46.7	1,996	1,996	4,420	176,227	176,227	352,454
Continental	4,420	4,420	46.7	1,996	1,996	4,420	176,227	176,227	352,454
Delta	4,420	4,420	46.7	1,996	1,996	4,420	176,227	176,227	352,454
Eastern	4,420	4,420	46.7	1,996	1,996	4,420	176,227	176,227	352,454
Northwest	4,420	4,420	46.7	1,996	1,996	4,420	176,227	176,227	352,454
Southwest	4,420	4,420	46.7	1,996	1,996	4,420	176,227	176,227	352,454
Trans World	4,420	4,420	46.7	1,996	1,996	4,420	176,227	176,227	352,454
United	4,420	4,420	46.7	1,996	1,996	4,420	176,227	176,227	352,454
Western	4,420	4,420	46.7	1,996	1,996	4,420	176,227	176,227	352,454

1. Statistic figures show combined domestic and international operations.

2. Statistic figures show combined domestic and international operations.

3. Statistic figures show combined domestic and international operations.

## MISSILE ENGINEERING



TEST FIRING of the XRD-1 Rocketdyne double liquid-propellant rocket motor was conducted at Inlet Wells, Calif., with the test vehicle fastened to stand. Instrumentation pickup lines are stretched for data collection.

### Beech Missile Target Nears Service Tests



MADE TO TERRIFY LAUNCHERS for destroyers and cruise could be adapted to fire the XRD-1. Target also could be launched simultaneously to simplify tracking systems. Target and launchers are not in same scale.

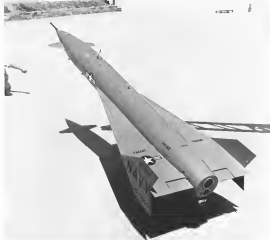
Wichita, Kan.—Beech Aircraft Corp.'s high-and-low-altitude supersonic missile target is nearing completion of contractor flight tests and between October and December will begin a series of demonstrations to U.S. Navy and U.S. Air Force, which are potential customers for the vehicle.

The manufacturer expects that Navy will be able to start formal service evaluation of the new target only next year. Known to the Navy as the XRD-1 and to the USAF as the XQ-12, the liquid rocket-powered vehicle already has been tested up through Mach 1.6 at 55,000 ft and is expected to achieve its designed Mach 2 performance soon.

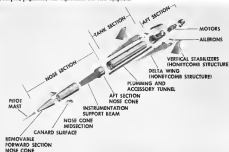
#### Current Plans

Current plans call for the first 16 drives to be powered by a North American Aviation/Rocketdyne XLR-6A-2 storable liquid rocket engine and follow-on vehicles are to have the NAA XLR-6A-4 powerplant which features variable nozzles for modifying the thrust.

Plans for the target stress its adaptability to use in land, sea and



SHARPLY SWIFT DELTA WING gliders of XRD-1 Mach 2 target is shown in overview of full scale mockup. External nozzle houses two rocket motor nozzles in individual segments. Below, exploded during shows only accessible area which carries wiring system, telemetry, programmer, radio apparatus and other equipment.



# match system sensitivity to your recording application

When your recording application calls for 6 or 8 channel wiring, general purpose channels with standard sensitivity and input impedance, Sanborn "950" design provides a highly useful, economical answer to the precise sensitivity range you want. Choose models to your needs.

- HIGH GAIN AMPLIFICATION** ... 6 or 8 channelized channels with fixed and guarded inputs. 100,000 ohm resistance to 70 volts; 10 to 2000 on the sensitivity. System output 50 to 100 (a) within 2% of 10 db peak to peak amplitude. Common mode performance  $\pm 20$  volts, max. resistance 100 ohm at 100 Hz. High pass threshold, max. gain factor by 10% low noise and drift. All channels have input gain, feedback protection and galvanic isolation between measurement contacts.
- MEDIUM GAIN AMPLIFICATION** ... 6 or 8 channelized channels with fixed and guarded inputs. 10,000 ohm resistance to 70 volts; 10 to 200 on the sensitivity. System output 50 to 100 (a) within 2% of 10 db peak to peak amplitude. Common mode voltage 5000 volts, max. gain and 140 db gain at 100 Hz. Same contacts as high gain amplifier.
- LOW GAIN AMPLIFICATION** ... 6 or 8 channelized channels with fixed and guarded inputs. 10,000 ohm resistance to 70 volts; 10 to 200 on the sensitivity. System output 50 to 100 (a) within 2% of 10 db peak to peak amplitude. Common mode voltage 5000 volts, max. gain and 140 db gain at 100 Hz. Same contacts as high gain amplifier.

All "950" systems have 255-style 6 or 8 channel rack-mount, metal right enclosure, using backdoor acceptance standards. Performance: New standard systems have 1000 ohm input impedance. Systems based on 1000 ohm input impedance have 1000 ohm input impedance and 1000 ohm output impedance. All systems have 1000 ohm input impedance and 1000 ohm output impedance. All systems have 1000 ohm input impedance and 1000 ohm output impedance.

SANBORN "950" SYSTEMS

INDUSTRIAL DIVISION  
**SANBORN COMPANY**  
170 Wyman St., Weymouth, MA 01978

an ocean beach water. It is designed for launching from the North Atlantic and the T-111 (control tank) at St. Mary's has been carried out using this type and the T-111, Comanche T-111, North American F-4 and Douglas A-1H and F-101, Comanche F-101 and F-105 and Martin B-57. Consolidation has also been given to enabling the close to be launched from land and ship-based launchers and T-111 launchers, with ships to St. Mary's target and made to the same launchers to simplify fleet operations. The general launchers, the ships can also be launched from a special launchers, with launchers as it may be adapted to launch from St. Mary's launchers.

If testing is carried out on schedule, the new target is expected to enter military operations in 1967.

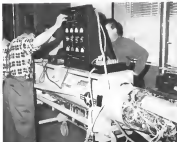
Measuring 11.8 ft in overall length with shaft diameter of 15 in. and a weight of 5 ft 5 in., the XKD12 (1-12) has a gross weight of 550 lb. It has a payload capacity of up to 1,000 in. in, permitting up to 475 lb. of special equipment to be carried depending upon the mission.

Construction is basically of aluminum with aluminum alloy delta wings, vertical stabilizers and engine support structure being of honeycomb metal. Wings have a magnesium cast through structure. Fuel and oxidizer tanks are aluminum alloy, with a cast-in-place of aluminum alloy. Fuel MA-4-4 (hydrocarbon) fuel, and the oxidizer and fueling system and engine, with nitrogen pressure, are supplied to dual thrust chambers.

Both types of Rocketdyne engines consist of a booster and sustainer thrust chambers, capable of being started and stopped from sea level to 100,000 ft. Both types of engines (NA-4 and NA-4) provide a maximum thrust of 5,000 lb. and a maximum of 15,000 lb. for the sustainer phase and 15,000 lb. for the booster phase and four engines maximum thrust for the booster.

Basic difference between the two engines is that the NA-4 incorporates a "dry" amplifier, low velocity, low thrust chamber that can be started and stopped during storage and handling and has a dry gas for the thrust section, providing low differential in the measurements. The NA-4 has a thrust chamber and a thrust of 16 thrust chambers for each tank pressure setting. The NA-4 engine measures 10.5 ft long, 5 in. wide and 9 in. high and has a dry weight of 167 lb. The NA-4 has a maximum 12 in. thrust, has the same width and height dimensions as the NA-4 and weighs 12 lb. dry.

Aside from the three engine capability of the NA-4, the two engines



**ELECTRONIC EQUIPMENT** gets checkout at St. Mary's using electronic gas that sets ship platform that exists on the target's back for accurate heading.



**TARGET'S ROCKET ENGINES**, shown, are only assembly. Before, common fuel target at St. Mary's, where contract flight program was completed.





genus: homo • species: sapiens  
discipline: factors engineering

At the six major RCA Defense Electronics Products facilities, teams of psychologists and design engineers are deeply involved in the highly specialized, incredibly complex study of human factors engineering—man/machine interfaces, auto-instrumental methods, decision processes, read-in/read-out optimization techniques, sensory perception, the entire spectrum of psychological-physiological-physical disciplines.

Whether your requirements involve human factors study of command and control functions for defense networks, or projected life support systems for space exploration, a total RCA capability stands ready to assist you . . . from feasibility study to project completion. Write Defense Electronics Products, Radio Corporation of America, Camden, N. J.



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U.S.S. Tullibee uses the world's largest, most powerful underwater sonar system, developed and now being produced by Raytheon.



World's smallest, lightest autonomous dip sonar, developed and produced by Raytheon for U.S. Navy's ASW operations.



Raytheon surface sonars are in world-wide service with the navies of the Free World.



## Raytheon's 60 years' experience in sonar helps meet the threat in hydrospace

For over 60 years Raytheon's Submarine Signal Operation has led in advancing revolutionary hydrosonic concepts — beginning with development of the world's first underwater acoustic navigation equipment in 1901. From advanced systems to hydrophones, transducers, drives, and amplifier components, Raytheon is today one of the United States Navy's chief developers and suppliers of airborne, surface and underwater ASW equipments that help meet the ever-growing threat in hy-

droospace for the nuclear age.

An example of this capability is the world's largest, most powerful underwater communications-detection system, now within the U.S. Navy's nuclear submarine *Thresher*. It is the first fully built-in ASW sonar.

Under evaluation by the U.S. Navy is the world's smallest, lightest autonomous dipped sonar.

Both were developed and are produced by Raytheon — typical achievements of Raytheon

Submarine Signal Operations ASW Center at Portsmouth, Rhode Island. Included among other significant achievements are advanced, fully transducer sonar units for surface vessels of the Free World's Navies.

A unique defense complex, Submarine Signal Operation's ASW Center is the nation's first completely integrated industrial facility devoted exclusively to the design, development and production of Anti-Submarine Warfare equipment and systems. Its ca-

pability is further augmented by scientific and technical support from Raytheon's 34 plants and laboratories coast to coast.

FOR BROCHURE of Submarine Signal Operation's capabilities, write: Raytheon Company, Department 66, Lexington 78, Massachusetts, Attention: M. B. Ceresa.

FOR EMPLOYMENT OPPORTUNITIES, write: P. Alexander, Raytheon ASW Center, Box 390, Newport, Rhode Island.

**RAYTHEON COMPANY**

EQUIPMENT DIVISION

**RAYTHEON**



Between this man's hand and a 5,000°F epoxyless torch flame is a 1/4 inch section of G-E silicone rubber. After 30 seconds exposure, the back-side temperature reaches only 100°F. In actual plasma jet tests, the same thickness of silicone rubber was exposed to a 5,000°F heat for 6 minutes. The back-side temperature rose to only 470°F, with 70% of the rubber remaining intact.

## Thermal barrier against 5000°F flame GENERAL ELECTRIC SILICONE RUBBER



### RESULTS OF PLASMA JET TESTS AT 5,000°F

Test Specimen:  
No. 12-200-1, 1/4" x 1/4" x 1/4"  
No. 12-200-1, 1/4" x 1/4" x 1/4"

Exposure time in seconds	Back-side temperature of test specimen at 1/4 inch center
30 seconds	100°F
2 minutes	210°F
3 minutes	320°F
4 minutes	370°F
5 minutes	420°F
6 minutes	470°F



The surface of the tested rubber remains brown, carbonaceous crust, while the underside remains flexible and unchartered. Preliminary tests showed the effective heat of rubber to be eight times that of presently used plastics, with one-fourth the rate of ablation and one-fourth the weight loss. How is it? Excellent adhesive coating with low thermal conductivity.

The above chart shows how the high thermal resistance of G-E silicone rubber is maintained during exposure to 5,000°F heat. It is also useful in mechanical and electrical applications at temperatures from -250°F to 500°F, where it remains resistant and flexible. It also protects its contents from heat and electrical stresses over this wide temperature range for selected periods.

Extremely high temperature testing goes on at General Electric's Missile and Space Vehicle Department in Philadelphia. There where a typical spacejet undergoing plane jet testing in an electric arc heated supersonic wind tunnel. Distances lasting less than a second now are on the thermal and ablation tests of G-E silicone rubber.

To learn more about G-E silicone rubber, and its uses as a thermal and adhesive material, write: General Electric Company, Silicone Products Dept., Section 11001, Watertown, New York.

**GENERAL ELECTRIC**



### Missile Circuit Tester

Standard circuit tests for electronic checks of explosive belts and other one-shot devices, powder motors, well circuit control which is below firing threshold of most modern explosive charge. Device, developed by Applied Physics Laboratory, The Johns Hopkins University, can sense anomalies from 0.1 to 10,000 ohms. The low current for continuous test comes from silicon photodiode which is illuminated by two long-pulsed laser signals before, both used to pulse to sense device action. Tester is used to check out Polaris missiles, but has application to other missiles.

to power extending throughout the state of Idaho plant where five pressure is automatically maintained at 1,000 psi.

Hydrocarbon content of the gases is monitored by a new device, are continuous infrared analyzer to check contamination level. The analyzer measures gas in ranges from 0 to 0.2 parts per million of butane in oil vapor. Sample pressure is 1,000 psi. Monitoring circuit is monitored by a highly sensitive electronic detector.

Atmos 1200 A liquid nitrogen cryogenic system has been installed at Montana's Inertial Guidance and Navigation Laboratory in Chicago. The station automatically provides high purity nitrogen at 1.15 psi for use in checking out site guidance systems.

### Skybolt Powered Flight Expected by End of 1961

Powered flight tests of the Douglas Skybolt air-launched ballistic missile are likely to begin at USAF Eglin Gulf Test Range, Fla., by the end of this year if the record of highly successful re-deployments tests for combat.

Separation drops were successfully followed by a series of modifications, introducing speed that provided positive clear trajectories of the missile from the B-57C testbed planes and a further drop checking out Skybolt's trajectory will be made soon prior to powered flight.



if you're putting money  
into space power conversion

### ITT EXPERIENCE PAYS OFF

...because we've been there before

on the JPL Project Ranger I and II space probes, for example, ITT has designed, manufactured and delivered the complete power conversion system, processing 33 different outputs from 3 input sources. Our unique quality of knowledge will significantly simplify your space dollar investment. For convenience, maintenance, replacement and control because:

- Much of your problem has probably been solved already by ITT.
- Our extensive in-house communications and digital acceptance test facilities compress test schedules, provide reliability control from design through completed system.
- ITT manufacturing offers unique proven efficiency—weight to save off.
- A thorough layout oriented ITT management assures schedule reliability and cost per for money.

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# 50 MILLIONTHS

## SPERRY

The rate of Sperry's new Mark I Mod. 2 gyro spins on a cushion of hydroplan, with clearances of only 50 millionths of an inch between it and the journal. The gas bearing, replacing the ball bearing of earlier models, reduces both graduation time and cost—and at the same time provides 300 to 400 percent higher accuracy for the Sperry Mark II SSG (Ship's Inertial Navigation System) designed for Navy's Polaris subs.

This big bonus in accuracy will be of vital importance to the Polaris missile; the entire system accuracy derives from it. And the accuracy must be there not for the few minutes it takes to put a missile on its trajectory, but for the days, weeks and months it is poised for action in the submarine beneath the sea. Actual Navy tests of production units of the Mark I Mod. 2 have shown it to surpass today's gyro stand units many times over. With slight modifications to present inertial systems, these second generation gyros can replace their predecessors for added navigational accuracies.



MARINE DIVISION, SPERRY GYROSCOPE COMPANY • DIVISION OF SPERRY RAND CORPORATION, STROBE, N. J.

## Rotary Motor Tested as Booster Control

By George Alexander

Indomptable-Solid propellant motors, fired with right-angle nozzles and rotating about their longitudinal axis, are being advanced by Allison Division of General Motors Corp. as a completely and independently thrust vector and attitude control system for boosters.

Allison, with an eye on the upcoming Saturn and Navy booster programs, says the system would overcome several propulsive efficiency and schedule problems by eliminating such potential problems as flexible joints, seals, moving actuators, pistons and other control devices now used in solid and gas-turbine engines. Thrust of the motor system, the company says, would be sufficient to compensate for their weight, which would be greater than conventional thrust vector control (TVC) systems.

### Direction of Rotation

The motors are rotated around their longitudinal axis, the least moment of inertia.

According to Allison, the approach visualizes the actuator forces required for rotation and also makes it easier to install the system on other propellant motors.

The company, after two actuation mechanisms—electrical and hydraulic—decided using a motor to transmit signals from the guidance and control system to a conventional gas-drive mechanism and the latter—also standard—being recommended for motors above 11,000 lb. thrust.

### Response Rate

Response rate of the system would vary with the limits of angular deflection specified for the system and the time allotted for actuation. Allison claims that the system can be as fast as 1,000 radians per sec.

Motor size, type of propellant and burning time would also vary with the booster vehicle and the mission. To control the attitude and adjust the velocity of a Nova-type booster, Allison estimates that a series of four motors, developing between 75,000 and 170,000 lb. thrust each would be required. For application to smaller vehicles—such as a Scout or Thor Delta booster—the company believes that four motors, each with a thrust approximately 1% of the main stage booster, would be sufficient to control the vehicle along all three axes.

The rotary motor, Allison explains, is within the present state of the solid propellant art. Thrust levels, pro-

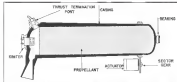


FOUR-MOTOR SYSTEM, used by Allison in demonstration tests for NASA, was mounted on a fire-flooding platform within a rigid frame. Springs and weights were attached to the system by the overhead pulley to introduce stress for the system to correct.

## WESTINGHOUSE ULTRASONICS

**A reliable production tool . . . cleans almost anything better.** Do you need absolute cleaning of metal, glass, ceramic or plastic parts or assemblies? Westinghouse ultrasonic cleaning can do it. It's fast, production line adaptable, too. Generators are available, transducers are made like Westinghouse standard—Westinghouse supplies light metal bases and service. Write: Westinghouse Electronic Equipment Department, 2510 Wilkes Ave., Baltimore 3, Md. You can be sure—8721

Westinghouse



**CRUWAY** of the solid thrust motor and attitude control motor being developed by Alliant for large booster applications shows solid housing, propellant grain, and component parts. Motors are mounted about their longitudinal axis, the least amount of inertia, to reduce reaction time and loss of speed.

ply and burning times of the motors would all be dependent upon the system's supercritical-high thrust over 60 to 140 sec when most powerful as the TVC unit on a large, four-stage booster or low thrust over seven hours of seconds when used to control a deep space probe whose flight profile calls for long coast periods between episodes of upper stage.

The motor is a large and burning grain design. The nozzle is tilted at right angles to the casing to allow for rotation of the motor along its longitudinal axis. Thrust termination is achieved by blowing out a part upon command from the guidance and control system. The thrust port is removable, a second nozzle, located 180 deg from the main nozzle, can be ignited once after blowout, can be either rotated, ignited or damped, or can be stopped, depending on the mission. In 2-1/2 Alliant says it demonstrated three units within 1/4 sec of the desired velocity.

The flexibility of the system Alliant believes stems from its control rather than an individual control unit for each stage of a multistage vehicle or in the single TVC system for a vehicle when control must be the payload. In the latter or booster-mounted arrangement, the separate ports not just a great amount of pre-stage cooling could be eliminated and vehicle burning effects reduced.

### Reliability Advantage

Alliant feels that a hybrid system would increase the overall reliability of the vehicle, even when the absolute problems of heavier support structures and shielding for the upper stages are considered. The company proposes that its system—in any configuration—would be tested 2 to 4 sec before main stage ignition so that it could be checked out prior to commencement of the complete booster to launch.

So far, Alliant has conducted 20 test firings of this system mounted on a four-stage pad-mounted Thrusts have ranged from 40 to 700 lb and burning times from 1/2 to 14 sec, and as long as 140 sec. Propellant, cast in section of several sizes, have ranged from specific impulses of 210 to 260 sec and have been of the polynuclear category. Most burners have been between 0.61 and 0.85.

Both the electrical actuator and hydraulic actuator have undergone testing according to Alliant.

### NASA Contract

Alliant started the project originally with its own funds. About a year ago, the National Aeronautics and Space Administration became interested in the concept and awarded the company a fixed-price contract of about \$500,000 for further testing. Recently, NASA awarded Alliant a supplemental contract of approximately \$150,000 to continue investigations of long-term, long-term testing.



**SMALL SYSTEM** suggested that Thrust Delta and Start system would be mounted at the head of the launch vehicle. Unit would weigh about 20 lb, loaded with propellant and about 16 lb at burnout. Thrust would be about 40 lb over 50 sec.



## IN 1961 LOOK TO BELL FOR THE FIRST STRING TURBINE TALENT TEAM

At Bell Helicopter, this "first-string" leadership has been earned by delivering consistently superior performance in the development of turbine-powered helicopters.

This is the Bell record: 19541 first in the world to fly a fixed turbine-powered helicopter test-bed . . . the XH-13-P, equipped with an Artouste engine . . . for the U. S. Air Force using an Army helicopter . . .

19541 again first in development with flight of the T-63 powered XH-40, prototype of the presently operational Army HU-1 series, holder of seven world records and the first turbine helicopter designed for specific mission capability . . .

19601 still the leader with the first T-63 turbine-powered 6-place helicopter test-bed, the U. S. Navy HU-1-SM.

19611 one of the companies selected to develop a prototype of the Army's Light Observation Helicopter . . . an extension of Bell's know-how with the Alliant T-63 gas-turbine engine/helicopter combination.

This constant pioneering desire to test-out and deliver proven turbine-powered light helicopters in typical of Bell's turbine talent team . . . experienced, practical minds which constantly anticipate new performance goals in Bell's dedicated policy of leadership in turbine helicopters.



# Hardware?

Maybe connectors were "hardware" twenty years ago.

Then a when the P-38 was the fastest fighter plane we had Plots were posed when they could hit 300 MPH and go up to 50 or 60 thousand feet. With due kind of performance requirements, most connectors worked without a hitch. You just connected them and forget about them like nuts and bolts.

#### NOW TIMES HAVE CHANGED

Now we're up around Mach 5 and altitude has been pushed into outer space. Nose cones light up like giant soldering irons and components have to operate in a near vacuum.

Fortunately Amphenol engineers are that the old "hardware" concept was limited on the window. Programs coming up were going to meet conditions that could put up with terrible environmental conditions of heat and shade cycling. For example, at high temperatures, most of the elements used in metal materials in connector pins either melt into a puddle, turn into a powder or get up and lose compression.

What's more, connectors now have to keep on functioning all the time with no allowance for failure. So—Amphenol designers went to work developing a connector to meet the new space age standards.

#### DESIGNING SOLUTIONS

The Amphenol Materials Lab with the help of a shiny new infrared photomicroanalyzer began detecting dangerous molecules. They were able

to pinpoint the weak spots in molecular structure where breakdowns began. Then they were able to plan and build new molecules with built-in "armor" to protect against failure. Results: no excessive silicone, solder compounds that oxidize in a variety and elasticity under stress temperature extremes and also withstand exposure to violent new propellants like hydrazine and nitrogen tetroxide.

At the same time, Amphenol design engineers were hard at work perfecting metal-to-metal bonding of mating shells that allowed pressure can hold over compression of the mating ring. In addition, the metal-to-metal design disposed vibrational stress more easily more effectively than soldered joining. Finally, they incorporated a new rigidized deflection disc to control metal expansion under thermal stress.

Having all the pieces, we put them together, called it the Amphenol 48 Series and started testing in the vac-

uum chamber. 48 Series connectors operate very nicely at a simulated altitude of 300,000 feet. They are quite comfortable up the hot box at 200°C (400°F), correct. *Full rated current.* They don't even need going up to 600°C if they don't have to stay too long. In short, Amphenol 48's can take almost anything you throw at them.

#### PROVE IT, WARD

Amphenol designers have established criteria for determining connector time temperature current capability. This information will be especially valuable to engineers primarily engaged in "evolve" projects, perhaps the kind of project where previous connectors have failed to measure up to the new space-age standards. If that's the case, contact an Amphenol sales engineer. He's a "space age hardware" expert. Or write directly to Bob Dorrell, Vice President, Engineering, Amphenol Connector Division, 1534 South 14th Avenue, Chicago 50 Illinois.



High altitude air tests are dramatic enough. By simulating an air light and 48 Series Connectors employ extremely high voltage safety factors.



While Amphenol 48 Series Connectors are normally rated at 200°C, they can still withstand considerably higher short-term temperature exposures.

Amphenol 48 Series Meets MIL Spec C 20300 (SMA)

## ROOM TO THINK...

Working at MITRE gives you the opportunity to investigate new scientific areas, and, at the same time, to become identified with projects of the utmost national urgency. The effort involves a wide range of computer-based command and control systems. You will face important and challenging problems... and be free to pursue them on your own. Your colleagues will be some of our finest (and most professional) scientists who work in an atmosphere of intellectual freedom. This is a job for the highly talented scientist or engineer — the man with imagination, common sense, and a flair for systems. If you qualify, and if you are prepared to accept the challenge of command and control systems, MITRE needs you now. Write, in confidence, to Vice President Technical Operations, The Mitre Corporation, Post Office Box 208, Dept. WE10, Bedford, Massachusetts.

Appointments are now being made in the following areas:

- Operations Research
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- Computer Technology
- Human Factors
- Advanced Systems Design
- Mathematics
- Radar Systems and Techniques
- Air Traffic Control Systems Development
- Airframe Design
- Manoeuvre Concepts

For more study the opportunities of the Massachusetts Institute of Technology, and how to join its Technical Staff, visit us in the United States Air Force Graduate Application Division.

*An equal opportunity employer*



## SCIENTISTS AND ENGINEERS:

### Follow-On Atlas Programs Mean New, Long-Range Opportunities.

Now operational, the Atlas weapons system stands as a unique symbol of scientific, engineering and military achievement. The design, development and testing of this reliable missile was an undertaking of immense complexity. Scientists and engineers at General Dynamics [Astronautics] worked consistently at the most advanced state of the science and technology. Boldly, they introduced and proved entirely new concepts of reliability, and in record time they developed the Atlas.

The same depth of imagination and technical daring is now at work modifying and adapting this sophisticated machine for a variety of civilian and military space missions. Demands of specialized orbiting and inter-planetary vehicles will depend upon the power of Atlas to thrust them into space. These programs reach far into the future and require the skills of highly powerful engineers and scientists in many technical disciplines.

Atlas is the free world's first space-oriented ballistic missile, the first missile to travel more than 9,000 miles across

the earth's surface, the only one to lift itself into orbit. Atlas marked the first use of inertial guidance for directional control and it was the first to use airframe skin as fuel cells. Many more "firsts" lie ahead for this reliable rocket. If you are the sort of creative engineer or scientist who can contribute ideas and solutions to the problems surrounding the mastery of space, you and General Dynamics [Astronautics] have a common interest.

*You'll find most of the details on this and the following page plus a convenient inquiry card. If the card has been received, or if you wish to furnish or request more detailed information, write to Mr. R. M. Smith, Industrial Relations Administration-Expanding Dept. J20-95, General Dynamics [Astronautics], 3654 Kettering Villa Road, San Diego 12, Calif. (If you live in the New York area, please contact Mr. T. Corbin, manager of our New York Placement Office, 1 Rockefeller Plaza, Circle 3-5044.)*

GENERAL DYNAMICS



ASTRONAUTICS GUILD

(Formerly GD&A [ASTRONAUTICS])



General Dynamics | Astronautics is located in San Diego, California, the third fastest growing community in the United States. It is situated 70 miles north of the Mexican border and a little over 100 miles south of Los Angeles.

**SCIENTISTS & ANALYTICAL ENGINEERS:** With Ph.D. or Sc.D. for electronics and physical research, computer analysis and application, and instrumentation development.

**ELECTRONIC DESIGN & TEST:** Communication systems and data transmission design; logical circuitry; automatic control systems; and electronic packaging. ESD: plus appropriate experience required

**MECHANICAL DESIGN** ROME or AE for pneumatics, hydraulics, and fluid systems design and test. Also include GSE and missile structures elements.

**RELIABILITY ENGINEERING:** San Diego openings exist for experienced engineers with applied higher mathematics education, preferably in statistics; higher degrees preferred. Circuits analysis with transistor and diode experience is also desirable.

**PERSONNEL SYSTEMS (MAN/MACHINE ANALYSIS):** Specialists capable of evaluating the personnel function from a systems standpoint. Requires analytical approach to applying manpower to an existing system at the customer level. Broad technical system background, with emphasis on human relations is essential. Assignments involve analysis of manpower requirements and applications for a weapon system, including equipment, procedures, time studies, logistics and training. Degree required, preferably in industrial engineering, business administration or industrial psychology.

**ENGINEERING WRITERS:** With 2 years' college and 1-3 years' experience in preparation of TCTO's, Operations, Maintenance, and Overhaul manuals.

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Figure 1. A schematic diagram of the experimental design. The subjects were divided into two groups: the control group and the experimental group. The control group received a standard training program, while the experimental group received a modified training program. The subjects were then tested on a series of tasks, and their performance was compared between the two groups.

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## GENERAL DYNAMICS



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## BUSINESS FLYING



**FA-5500 COUPLER** is one of the new turboprop executive aircraft revealing the multifunctional passenger field in the business aircraft market. The 5 to 10 place aircraft will be built in Italy with first deliveries scheduled for 1993. First flight is expected in late 1992. Preliminary design work was done at Douglas U. S. facilities; final design is being completed in Italy.

## Turbine Executive Aircraft Gain Impetus

By Edwin J. Fulkner

Taha, Oda—Tunnel evolution, re-

used by airline transport aircraft is threatening to reduce the use of one-chaus and leave two-engine, piston-powered aircraft to the point where it will no longer be profitable for businesses to own them. Tom Harris, vice president and general manager at Aero Commander, Inc., indicated to members of the National Business Aircraft Assn. at the group's 14th annual meet-  
ing here.

Both business aircraft operators and manufacturers must soon make decisions regarding the purchase and development of turboprop-powered aircraft, he said.

**Tracking Performance**

Flann's statements as well as those of other speakers, left little doubt that the business severely lacking was in its fail-  
ing as a broader scale than can be  
low. Turbopowered equipment is  
rapidly penetrating the marketplace,  
here also, from the North 18 up to the  
World War II turbine conversions of  
the C-47, Lodones and #26, which  
have to be discarded the market.

Tuition-powered computers, both actual hardware and proprietary software for the system, are used to train the user.

to replace. Evidently the petros metacarpal held the pectoral girdle at this meeting place of bladders and bones.

Initial production by the go sets the upper scale of this market has been made in the non-sustainable low regime. Lockwood Jetties, the Gloucester Gulf-Straitford Line had 477 and General 140 440 indigenous individuals are that there could be little further competition in its own waters in the night class possibly because it appears that there no longer exists a sufficient market to support the costs of further development and sales persons.

Indications are strong to fear that the homogeneous languages are already eating the top of their sales potential and only a substantial currency order can still enable these manufacturers to continue at their current production pace. Without such an asset it appears that although sales to business operations are still possible, these would probably be at such a reduced rate as to be less

show that serious economic problems would confront the manufacturers. Contributions and beginning of delivery of products JetBlue introduces a competitive factor that the turbo-prop aircraft market has previously not had to cope with. First composite JetBlue was delivered to Continental Oil Co. late last month and approximately 11 will be

delivered by the end of this year, about one-third for military use.

Lachland Minnerts spokesman stressed that the company now has sold 41 of the trempoats, of which approximately 75% are going to the sanitary. Production of the sets of about 500 a month, with 15 families ahead of their pups and moving down the assembly line.

## Turkish Gulfstream.

General Motors is aware of the competition from the market in its market class and already has developed a follow-on jet system of the turboprop Gashorn, to keep its engine in the picture. Basically the program would provide purchasers of the turboprop model with the capability of later buying their engines upgraded by the addition of four General Electric CF700 jet engines having wider area wings on existing 15-deg sweep and new landing gear.

Most attractive way to approach this model, according to a Gloucester spokesman, would be for California lawyers to accumulate more than three years of prosecution verbiage on the anthropology diploma, making it easier to patch the modification cost of approximately \$300,000-500,000.

The new device, designed at NELA,

# WING TIPS



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an array of working orders down the right side to a broader market and reducing the impact of the turbine on burner design. These smaller turbo-propeller engines will have a competitive advantage in current power-powered types in the Air Commando and Beech 18 usage and are directly responsible for getting pressure on those two established business flying same factories to make them current designs to go ahead with new development projects. Indicators are that the Jet Commander 1121 probably placed a major role in Beech's recent decision to largely convert back to a single-engine turboprop with deliveries expected in 1964 (AW Oct. 2, p. 29). The Commander looks most likely to threaten Beech's long-standing role in supplying this turboprop category as the Wichita manufacturer cannot afford to be ousted from this market.

The new line up of entries, including Beech's, is this light jet field, being the total of design and progress is right and Lockheed is a stiff competition for survival in the next few years since it is unlikely that the market can support more than half the number. Of the established business turboprop companies, two major firms have not yet done any talking about their turboprop plans—Cessna and Piper.

A high-level management source with Cessna told Aviation Week that the company has spent considerable money and engineering time based on wide areas of development but that it was unlikely an announcement regarding a line commitment would be forthcoming at least for some time. Price spec for this jet that Cessna feels that the correct jet may not yet be feasible in the price line and therefore is not yet competitive. This same thinking would probably also apply to Piper.

## Outside Impetus

There are also indicators that this business could be more in a working order, faster than many manufacturers and aircraft operators would like, but a major part of this suspicion is being supplied from the outside by the speed differential now provided by the as yet not completed in the current power engine business fleet.

It is becoming increasingly difficult for companies to continue to patch their large types of large major companies in view of the holding of just long-range schedules in the current. To most competitors from those who use the jet for business trips, the power engine business is being lost, and some are in a hurry to move with the second wave jet movement. The pressure will increase further when the airlines expand their jet operations to shorter route segments with the Jet



SEVEN-SEAT INTERIOR of Beech-Douglas D158 (above) is one of two versions developed for the aircraft. Turbine turbine eliminates competition between passenger and cargo. Douglas, below, is relatively unaltered.

Commander and Beech 717 class airplanes.

This will put a burden of production on these companies whose operations segments are in the 500-hp category, basically the major parameter included in the specifications of the new generation of light jets. Industry sources feel that some companies will have to use turbine aircraft or reduce their activity in using smaller aircraft or even get out of the business aircraft picture. Additional pressure will be generated by one of their competitors who already have jet equipment—150 to 200 turboprop and turbine business planes should be operational in the Western Hemisphere and 100—and be the decreasing rate of the power plane as a state model in an age of jets.

Of the light turbine aeroplanes, only two are turboprops—the Beech G55 and the French Pacer P444, which is expected to make an U.S. debut this April or May under the sponsorship of Don Powers TurboFlight, Inc., U.S. distributor for the French

turbine airplane. The turbine, which will be certified at a gross weight of 15,000 lb., will sell for \$450,000; however, a \$40,000 support date. Initial customer data may be made in the third quarter of 1963 (AW Oct. 2, p. 24).

Also Commander appears to have a hard time in production of the first U.S. light turboprop built expressly for the business owner. Avco Aero-Wing is told that the company already has two line production line positions as signed to corporate buyers, with nine additional orders under negotiation.

A dark horse in the light jet category appears to be William Lear's Swift Aerospace Aviation Corp. SAAC 25, primarily because of the price he quoted last—\$250,000 for a basic airplane, fewer alterations, Sweden-made engine electronics, engine, auto pilot, instruments or auxiliary power unit providing ground on road-testing. Lear maintains that he will be able

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## Modification Center

Tolu, Calif.—Continental states that world-wide standards for aircraft modifications is planned by Federal Aviation Agency at its Oklahoma City Aeronautical Center, according to Administrator Najab Siddiqi.

Although the operation will be concerned with pricing on all aircraft modification proposals, the supplemental type certificate work done on heavier aircraft probably would have a major share at the facility. Modifications relating to such as operations, according to Siddiqi, would be to provide a "one-stop" operation that would analyze and test for approved modifications programs which are meet with revised operations, according to a study session. Depending upon the FAA region in which approval is sought. The center would establish basic criteria for aircraft model and approval of design modification work, as the basis of actual flight test programs conducted under FAA supervision.

to meet the low price schedule—fully equipped, he says, the airplane will cost approximately \$148,000, which would be some \$193,000 less than its custom-price jet competitors—in manufacturing a light grip on aircraft and engineering costs. This includes shipping some components already proved up the Series P16 jet fighter using top-flight engineering talent on a job contract basis and considerable use of low-cost East Asian computer time for much of the design efforts.

## Designs Extended

Less states that he has already received drawings involving parts for the initial batch of 25 production aircraft and expects to have the first plane, which will also act as a production prototype, flying next April, with deliveries then completed possibly as early as next September. The new production wheel also call for delivery of the first 25 SVAC 24s in the first six months of 1985, with a total of 75 units delivered that year. In 1986, he expects the new gear will build 130 airplanes and production will be stepped up 20% thereafter. He states that the first pro-

## PD-808 Weighs

Maximum takeoff weight	35,000 lb
Maximum landing weight	24,000 lb
Intermittent flight gross wt.	(50% fuel) 22,250 lb
Landing gross weight	(60% fuel) 9,740 lb
Weight empty	7,517 lb
Maximum payload	2,600 lb
Fuel	(fuel tank) 3,400 lb (331 gal)

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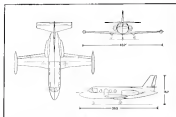
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JOHNS-MANVILLE



THREE VIEW OF PUGGIO-DODGE PD-808 shows "butter" wing flexing uniquely fixed, offset control surfaces and symmetrical tail fins

PD-808 Data	
Dimensions	
WING	
Area	325 sq. ft.
Span (w/Tip tested)	40.67 ft.
Mean span	33.1 sq. ft.
Tip type	Single-dihedral
Wing area deflection	40 deg.
Tip tank capacity	112.5 gal. max.
HORIZONTAL TAIL	
Area	70 sq. ft.
Span	37.81 ft.
VERTICAL TAIL	
Area	16 sq. ft.
Span	7.3 ft.
FUSELAGE	
Forward area	27.1 sq. ft.
Length	39.5 ft.
CABIN	
Height	17 in.
Length	140 in.
Seating capacity	324 in.
Weight	443 lb.
COMPLETE AIRPLANE	
Total weight max.	1,250 sq. ft.
Performance	
Engine	Two GE C46-101 to 100 hp
SLS max. (thrust)	2,418 lb.
Takeoff speed	340 mph
Takeoff time 50 ft. altitude	2.76 sec.
FAA field length	4,020 ft.
Max. cruise speed	310 mph.
Service ceiling	40,000 ft.
One engine operation	30,000 ft.
Power at stall speed	
(1) loading gear weight	91 mph
Approach speed	139 mph
Landing gear 50 ft. altitude	2.15 sec.
FAA field length	3,900 ft.
Rate of climb at 51,000 ft.	7,440 ft/min
One engine operation	2,175 ft/min
Landing gear speed (mph)	10 ft/min
Maximum flight duration	4 hr.

port for the new airplane has indicated he will take three costs.

East expects that he will get military orders for the SAAC-11, noting that the airplane will have a capability not only for high speed VIF transport and some training missions, but will also be adaptable to tactical combat. It is viewed as a pure and one-of-a-kind nuclear weapon delivery aircraft as well as a multi-ground nuclear attack, with speeds ranging up to 86 (75) in miles.

To handle the Western Hemisphere market, East said that he plans to select a U.S. assembly site somewhere in the Midwest, possibly depending on a location in the next month. This facility would employ approximately 180 people when in full-scale operation and will be duplicate tooling now being built in Switzerland. Complete set of production tooling is already being for the SAAC-11 is expected to be ready in May, 1963.

### Staged up Efforts

Douglas Aircraft Co. is stepping up its efforts to get the PD-808 into the plane into jet executive transport program underway at its Denver, Puggio Co., near Genoa, Italy.

Plans call for flight testing the first prototype late next year and first deliveries in 1963. The 100-mph plus cruise transport will be powered by two General Electric C46-101 or Bristol Armstrong Siddeley Viper 20 engines.

Preliminary design on the two-year-old Douglas project has been completed and detail design work is being started at Puggio. The firm of a team of Douglas specialists engineers already has left for Italy and PD-808 Project Engineer, Floyd C. Norton, Jr., was scheduled to leave this month. Douglas engineers already have gone through the system

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**CZECH-BUILT, SELF-PROPELLED** two-wheel tractor which is fitted with a TATRA 100 diesel engine rated at 194 hp. (left) A total of about 400 will have been produced by the end of this year. Section of Czech-built airport lighting equipment (right), occupied first place among the earlier aviation exhibits of the year's New Trade Fair. Although not shown in photo, the equipment includes both automatic runway lights and back-mounted cross-direction lights.

lightbars, the high wing, four seat L-60 Aero series, including the Aero 45 and Super Aero I and II, have been produced since 1947, of which about 50 were sold in Czechoslovakia, the remainder to various foreign countries. Production of this type was discontinued last fall, in which time the four-seater Aero L-200 Mianov, introduced in 1959, had proved its worth as a suitable replacement. This too, approximately 400 Mianovs have been built. Of these, 70 were sold in Czechoslovakia, production to CSA Casimirov Airfield for use in training at two operations, and 100 were exported, leaving Chesapeake with 90 Mianovs in reserve inventory.

Production of the L-60 Breguet still remains as the dominant Slovakian type in "two seat and occasionally for parent requirements, and the Czech market is saturated for the next two to three years," Chesapeake adds. Between 1947 and 1960, a total of 400 of this type were built and half of them exported.

To date, about 1,000 Tracer Master aircraft have been produced. Of these, approximately 200 are in service in Czechoslovakia, while the rest were sold abroad. Introduced in 1945 was the Z-215 Tracer Master from which the present version, the Z-235, is derived. Of the aircraft built, 252 were Z-215s. The most recent machine, bearing all vital assets, suitable for both primary and advanced training and for aerobatics, was first place in the First World Aerobics Championships held in Budapest, Czechoslovakia, last year.

► The Second World Aerobics

Championships Most held in Casimirov, England, earlier this year, a Tracer Master again won the event and was awarded the Leitchard Trophy.

Of the 200 L-60 Breguet sport and touring aircraft built, only a small number are in use with Czech flying clubs. The rest have found a rich market abroad, particularly in West Germany, the Scandinavian countries, England, Austria, Austria, South America and, most recently, Spain.

The Czech aircraft, however, has been L-15 Breguet built in 1958 found its first export market in Russia in 1959. This too, of the approximately 300 produced, the Soviet Union has received 100. Chesapeake says the model is becoming increasingly popular in

tropical countries and that Chile, one of the latest South American, has purchased three.

The Soviet Union also is the latest customer for the Czech Breguet 100 motor which introduced in 1959. A total of about 400 will have been produced by the end of the year. About 30 or 40 of these are being sold domestically, the rest were sold abroad.

First complete set of Czech-built airport lighting installations which went into active production earlier this year and on which Chesapeake is concentrating, a major job effort, was delivered to Russia which has several more on order. All domestic Czech exports are to be fitted with the lighting equipment. In some cases, export orders have been filled. An order list has been received from East Germany, and Chesapeake and its parent, a number of requests from Communist China, Africa, and Middle Eastern countries.

Manufactured by Elektromech, Prague, special features claimed for the equipment, which includes both constant current and cross-directional lights, are that it results in a saving in materials and labor of approximately 40% as compared with cathodes or incandescent and that, when used at airports with a runway of about 9,000 ft in length, savings in electrical current per year amount to between 150,000 and 200,000 kw-hr.

The newest aircraft engine section at Brno sports treatment models of the Czech-built Walter Motor 100-hp M 132 and 210-hp M 137 four stroke in-line injected engines, which provide the Aero 145 and Mianov respectively and which are in series production. A new model on the engine stand was a small four-cylinder, the smallest

M 130 3L, with a four-stroke crank and direct injection design. It is fitted with a few pneumatic injection pump which sprays fuel through injection nozzles ahead of the intake. Its weight is approximately 280 lb.

It has been designed as a pre-engine for both fixed wing and small rotary wing aircraft as well as industrial use. According to Chesapeake, a small quantity of the new engine is now being produced for the domestic market while it is to be fitted and prior to promoting its sale abroad.

## PRIVATE LINES

Warranty life on all 1962 model Cessna aircraft will be doubled from three to six months, the company has announced. Cessna, based in the extended territory, MA, of the Cessna line will be announced in November.

No major changes have been incorporated into the 1962 Beech Queen for 1961 model but a new paint design, new interior and an additional 10 in. of cabin space. Lighter materials used in construction, have increased the model load to 3,000 lb. Beech says basic price will remain at \$126,000.

Soviet Union has claimed new speed and altitude records in the jet sport plane category for the Yak 50. Soviet aircraft and the plane was placed without conventional wings in an aircraft of 16,125 sq ft (54,000 ft<sup>2</sup>) and weighed a speed of 707 mph (490 mph) in a 15.25 km course. (100 km) at 14,200 meters (about 47,000 ft) and original speed record held by the Yak-50, was 738.5 mph (approximately 461 mph). Data are being sent to the Fédération Aéronautique Internationale for verification.

Federal Aviation Agency has approved a parachute automatic flight system for the Leitchard Jetliner. The system is manufactured by the Leitchard Aircraft Co. a division of Soren (Soren) Corp. System, designated SP-40, provides production control of the aircraft and completes the system in order to be fitted on turbo-propeller and 115.5 hp. The SP-40 weighs approximately 75 lb and has an optional feature which enables it to recognize the aircraft through a duplex radio system.

State of North Carolina has purchased a Beechcraft Super C18 to end its current program to attract industry to the state. Industry leaders will be flown to North Carolina by the government aircraft and provided with transportation to prospective industry sites.

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**NEW FOUR-STROKE** aircraft engine, designed by the M 130 H, suitable as a pre-engine for both fixed-wing and multi-engine aircraft and also other industrial uses, was displayed at those for the first time. Its max has a dry weight of about 230 lb. When installed in a helicopter pre-engine, the weight will reach 270 lb.

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## PRODUCTION BRIEFING

Atomic Energy Commission is operating, will design the air storage system for the Toy-BAC nuclear drive (20,000 lb. to one million lb., and to modify related components for testing the Plate reactor concept. Bids for the job, estimated to cost \$6 million, are due Nov. 7 at AEC's Las Vegas, Nev., office.

Bole Aircraft Corp.'s main plant at Chula Vista, Calif., will produce power plant nozzles and other components for P-4V Orion ASW aircraft through mid-June, 1965, as a result of sub-contract recently awarded from the Lockheed-Christie Co.

AvcoEvrett Research Laboratory, Everett, Mass., division of Avco Corp., is studying methods for control, measurement and loading of satellites in predicted orbits under a \$197,124 contract from USAF Systems Command's Aeronautical Systems Division. Part of the study is devoted to transfer measurement ability to both aircraft and improve vehicles.

Danisco Mfg. Corp., subsidiary of H. I. Thompson Fiber Glass Co. at San Rafael, Calif., is producing all-plate nozzles for fuel and oxidant stage motors of Aero's Pershing missile. Nozzle weights less than half as much as a metal nozzle of comparable size, reportedly cutting missile weight problems appreciably.

Lock Division of General Precision, Inc., Binghamton, N. Y., has received a contract exceeding \$1 million from United Air Lines to produce air flight simulators for the carrier's new Boeing 720 turboprop transport. Simulator will be located at United's training center in Denver, Colo.

Navigraph Corp., North Hollywood, Calif., is producing 308 Model T1110 sounding balloons and 145 replacement balloons for the Air Transport Service worldwide world-wide. The contract, under a USAF contract holding 35-F1011, was awarded to the 50-sounding balloons to meet their requirements as a 74-hour basis.

Electronic & Marine Facilities, Inc., of New York, is building a system (Liaison) and office facilities for National Aeronautics and Space Administration's Marshall Space Flight Center at Huntsville, Ala. The \$4-million contract calls for a structure, which will house 275,000 sq. ft. including a ground floor for use and equipment floor. It will house the center's headquarters offices

and its Aeroballistics and Research Projects Division.

Wallo Aircraft Corp., Burbank, Calif., will design, develop, fabricate, test and produce an oxygen vent and several systems for USAF's B-57D Star named spare glider under a \$683,000 subcontract from The Boeing Co. Several systems will include parachute and emergency oxygen supply.

National Research Corp., Cambridge, Mass., will conduct a performance study of a custom propellant feed system for spaceflight ion engines, under the sponsorship of the National Aeronautics and Space Administration's Marshall Space Flight Center. Study, for an unducted aircraft, will investigate properties of various materials for design of the feed system and final methods for varying flow rates.

Koffman Instrument Corp., subsidiary of Standard Koffman Industries of Melrose Park, Ill., has received a \$7 million contract from North American Aviation's Aerospace Division for KS-149 Astro Tracker navigation systems to be installed on F-105D jet tactical fighters. Koffman also has been awarded a \$1,400,000 Air Force Aeronautical Systems Division contract for automatic auto compass (USAF contract is for MD-1 compass) and its installation in other systems for Koffman's navigational equipment which is presently being installed on B-52 as well as B-55 aircraft.

Prest & Whitely Aircraft Division of United Aircraft Corp. has established an Advanced Materials Research and Development Laboratory at P&W's North Haven, Conn., plant. It will develop new materials for the engine, wing and fuselage components. Principal goal will be development of lightweight metals, alloys for service at extreme temperatures and metals for creep resistance devices.

General Motors Allison Division has received a \$2,457,300 contract from Aero-General Corp. to develop and produce various second-stage rocket engines for use with the Martin's ICBM.

Lockheed Aircraft Corp. has awarded an additional \$1.2 million contract of \$1,077,676 for the second phase of a program to design, manufacture and test a research aircraft using the jet engine principle.

Thiokol Chemical Corp. will produce propellant liquid propellant rocket engines for Navy's Skybolt missile under a \$4,510,782 letter contract.

# TACAN ACCURACY RIGHT OFF THE SHELF



## TACAN test equipment from the world's largest maker of airborne TACAN

Hoffman now offers a new and complete line of specialized test equipment necessary to maintain TACAN accuracy in the field—thus insuring the superior performance built into airborne TACAN equipment. Compact and rugged Hoffman simulators are available as standard off-the-shelf items (Federal stock numbers assigned), and at lowest cost. Equipment tests all airborne TACAN models now in use.

ML-115A (AN-100-25)  
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Integrating portable unit (radio frequency) simulates ground receiver and transmits signals to aircraft. Includes automatic data processing and recording. Also includes a built-in test set for the receiver, transmitter and ground receiver. Also includes a built-in test set for the receiver, transmitter and ground receiver. Also includes a built-in test set for the receiver, transmitter and ground receiver.

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Integrating portable unit (radio frequency) simulates ground receiver and transmits signals to aircraft. Includes automatic data processing and recording. Also includes a built-in test set for the receiver, transmitter and ground receiver. Also includes a built-in test set for the receiver, transmitter and ground receiver.

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ML-115D (AN-100-25)  
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Send for complete data file on Hoffman TACAN test equipment and TACAN air navigational systems.

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# Pyrolytic Graphite

What it is...

What it does...

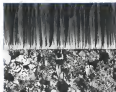
What it can do



Pyrolytic Graphite—now commercially available—is a polycrystalline form of carbon produced by gas deposition. It exhibits a molten behavior (high conductivity) in the phases of deposition, and a ceramic behavior (low conductivity) across the planes.

Some of its unique properties include: high strength at high temperatures up to 5000°F.; superconductivity to gases and liquids; excellent thermal and electrical conductivity parallel to the plane with insulating characteristics across it; is very lightweight.

Produced as a coating on commercial graphite, it can also be built up to sufficient thickness for use as free-standing parts. Pyrolytic Graphite is well suited for many space, missile and elec-



See structural difference between ordinary graphite (bottom) and Pyrolytic Graphite (top). Ordinary graphite has minute overlap of crystals with high density. Pyrolytic crystals have high degree of orientation and are porous.

tronic applications, including leading edges, rocket nozzles, and coatings for nose cones.

For additional information, write: Specialty Alloys Section, Metallurgical Products Department of General Electric Company, 11107 E-8 Mile Avenue, Detroit 32, Michigan.

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## SPACE TECHNOLOGY

### Reduction of Ranger Components Studied

By Russell Howkes

Newport Beach, Calif.—Design concepts used in the lunar landing program and associated payload for NASA Ranger 3, 4, and 5 is to minimize the number of operations which could have a critical effect on the functioning of the payload and vehicle, according to the efforts of Ford Motor Co.'s Astronautics Division, prime contractor for the sphere.

An important effect of this is to simplify reduce the number and weight of components and subsystem systems needed to provide equal data with equal reliability. Since the weight is fixed in the final unit to be placed about on the surface of the moon, the astronautics, operations and all the other vehicle components needed to transport the unit can be smaller and lighter. This makes the Atlas Agena II a feasible launch vehicle and Ranger lunar missions will begin before the end of April 1967, if there are no significant slip pages.

The landing capsule is a 15-in. dia fiber glass covered sphere made of halo segments fused together with the grain oriented radially. It weighs 96.2 lb. At the core of the landing sphere is the 11-in. dia, 35.3-lb. metal sphere containing the battery-powered transmitter and telemetry transmitter.

The accelerometer is a single-axis measuring device consisting of a spring-mounted mass with a variable reluctance electromagnetic pickup capable of measuring displacements as small as one millimeter or so much. It was developed by the CalTech Department of Aeronautics which shares with Caltech University the responsibility for the experiment.

The accelerometer is so simple that it cannot be tested at the Ford plant because of microwave lines waves breaking on the bench record meter. It is withdrawn the 2,000-1,500 angstrom of the laser beam, the suspended mass of the delicate instrument is kept by flaring it in a dual of equal density which is then removed after the landing.

Since it is desired to operate under the influence of the lunar gravity which is only 16.5% of earth's gravity, the accelerometer is laboratory-tested by tipping it at an angle so that the small component of motion for the suspended mass is induced in the laser experiment. The instrument is designed to measure

short-term seismic disturbances. It has a natural period of oscillation of one second. It will not record so-called tidal disturbances with periods on the order of two weeks. It is expected to record earthquake impacts as well as internal disturbances.

The covered sphere containing the accelerometer is fixed in a liquid and its center of gravity will be so located that it will never stall without any rest of shatter. The liquid will be composed of two very dense fluorine based at a population which will give it a density equal to that of the instrument sphere which will, therefore, have neutral buoyancy.

The fluorine liquid also distributes the impact load.

#### Liquid Damage

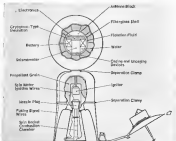
Since it was designed under a policy of minimizing the number of critical components, the accelerometer will function even if liquid damage is greater than anticipated and the cover sphere fails to resist in the fluorine fluid. In fact, it could even operate if the expanded cover sphere failed to separate. Data transmitted would be degraded but much useful information would still be given. The project officials claim a fully successful Ranger mission will double

the body of information known about the moon.

The telemetry transmitter located in the top of the covered sphere uses an omnidirectional cross-dipole antenna mounted on a halo bar above a superconducting plane that separates the antenna from the electronics and instruments, not so that there are no other earth components within a line of sight of the antenna. Tests have shown that the telemetered signal can pass through the halo impact container and fiber glass shield without too much attenuation.

Balloons were chosen to absorb the landing shock when NASA's Jet Propulsion Laboratory experiments found it to have about five times the impact absorbing power of the next best material. Astronautics engineers had been expecting to use a nylon honeycomb composite Impact Limiter until they heard of the JPL work. Fiber glass covered halo Impact Limiter spheres have been used several times in the laboratory and they have been observed to return in something approximating their original shape after having been crushed by impact. It returns in respect absorbing power in a vacuum and the outer fiber glass cover is not to be made an impact.

Lunar impacts simulated in the Aero-



GETAWAY DRAWING of Ranger lunar capsule shows components of signals targeted to land on the moon and deliver scientific data back to earth for a week or longer.



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extreme. Lubrication and in fact drops from several inches that the most damaging landing is a glancing impact rather than a rectal drop to the surface.

Data indicated from the several spheres is first associated to a rigid which is closer to impact than the original sphere surface. Spinal capsules will be installed at the Deep Space Instrumentation Facilities to record the signal to a comparable source time. The big DSIIF system is expected to be the only facilities which will be capable of reading out Ranger telemetry.

The Ranger landing sphere and spacecraft will be thoroughly sterilized to prevent biological contamination of the moon. Ford assembly so that contamination on the subject has completely disappeared and the same policy of sterilization has been used by the Russians even for their lunar missions because of the possibility of an accidental crash on the moon.

The decision to use a beta impact level in the landing sphere helps solve the sterilization problem because the standard Agave B covers impact at the high to be on a beta impact while but when the spacecraft separates from the Agave it will be turned 180 deg and small solid objects will pass it out of the Ranger trajectory.

#### Vacuum Isolation

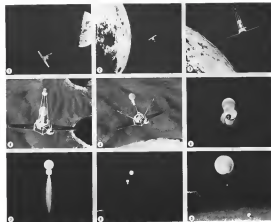
The temperature in the animal sphere is stabilized by a cryogenic-type vacuum insulation with alternate forms of vacuum foil and aluminum foil. There is a 15 lb. of water behind which will condense continuously to transfer better heat through the sphere. The two other mac batteries are semi-closed in design to fit the sphere.

The overall vacuum at impact for the landing sphere is 346 lbs. or 71 mph, but because of the large ones which are possible and acceptable in the system, Ford scientists prefer to use

impact velocity will be less than 150 mph.

The landing sphere will be decelerated to the speed from its 6,500-mph approach speed by a high performance solid propellant rocket developed by Hercules Powder Co. especially for the mission. It is reported to have a main rate better than 0.99 and the jets are shaped and loaded in such a way that thrust decreases with time as control deceleration as propellant consumption reduces the weight of the vehicle.

The proposed sequence of events leading to the lunar landing after separation of the Ranger spacecraft from the Agave B carrier begins with a mid-course maneuver which reduces any excessive correction in the attitude and a reorientation of the spacecraft to face its solar panels toward the sun. Attitude information is supplied by a sun sensor and a room sensor. Control power is provided by two small jets of compressed nitrogen. Thrust produced by these is so small that a 15-lb. or



**RANGER LUNAR LANDING SEQUENCE:** As long before reaching the moon, a signal from earth will alter spacecraft attitude. About 25 mi. from moon's surface, the spacecraft and capsule will separate. Sun sensor gives attitude information. Retro-rockets will reduce impact. Capsule will be control from the atmosphere and fall to surface of the moon. Capsule is being built by Ford Motor Co.'s Astronautics Division, for NASA/JPL Ranger program.





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## New MB-Zenith 150 KV pulsed X-ray system takes motion pictures of high speed phenomena



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tation at midcourse would take a full hour to complete.

Track information is calculated by the onboard guidance computer and transmitted to ground stations for comparison with tracking receiver data. If the track must be corrected, propulsion is supplied by a 50% thrust hydrazine monopropellant jet which fires at constant thrust for a time controlled by the magnitude of the correction. If necessary, three or four jets can be fired for multiple corrections.

About 65 sec. before impact of the unguided capsule, a terminal maneuver is made to point the nose of the nosecone of the nose cone will be initiated as commanded from a ground station. It is expected that all late events will be started automatically by the program over on board, though some can be initiated on command.

Fifty seconds before scheduled impact at an altitude of 4900 feet, automatic ejection of the nosecone is initiated. As the nosecone falls, data will be teletransmitted from the experiment package which will be obtained in the crash of the unguided nosecone. One of these is a gamma ray spectrometer and the effect is a nucleus of ionization.

At an altitude of 124,000 ft. and 600 sec. before the crash of the capsule, the radio altimeter will be turned on. It will be operating at 197,000 ft.

and 45.6 sec. before impact. When the altimeter indicates an altitude of 76,300 ft., it will send out a "go" signal to separate the landing capsule from the spacecraft. The impact produced by the separation is expected to increase the small airbags at altitude sufficient and separate the capsule so that the vehicle and the gamma ray detector will not burn on the moon but will keep operating until they are destroyed by impact.

A level of a second after separation, the spin motor mounted in the expansion zone of the landing capsule nose cone will spin-stabilize the capsule. Two seconds after separation, the auto motor will fire and the spin motor will be ejected from the nose along with the nose plug. The auto motor will burn for 10 sec. as the vehicle falls from 15,700 ft. to an estimated 1,000 ft. At launch the capsule will have brought the capsule to a dead stop.

From the launch altitude, it is to fall free to the surface of the moon, accelerating at 5.31 ft. per second due to the lunar gravity. Impact is calculated to be 21.9 sec. after the crash of the nosecone and at a velocity of 168 ft. per second. The total flight of the capsule is 5, 4, and 5 follows the planned sequence of events, including and it will depend largely on whether the capsule's horizontal component of motion is excessive.

### Ranger Weight Summary

	Weight (Pounds)
<b>A. Retrorocket payload</b>	
Electronics external battery wiring	21.1
Spectrometer, ionization device	14.4
Wiring	1.6
Sensor/meter	7.5
Flotation float and air cell	7.4
<b>Second stage total</b>	<b>56.5</b>
<b>B. Target</b>	
Target trailer, cover and rocket motor/propulsion subassembly	16.0
Vehicle design	1.0
Control lines, battery, wiring	1.4
<b>Total retrorocket payload</b>	<b>90.7</b>
<b>C. Motors</b>	
Roll motor and motor	306.5
Spin motor, igniter and attachment	2.2
<b>Total separate weight</b>	<b>308.7</b>
<b>D. Miscellaneous equipment</b>	
Altitude and spin motor	6.5
Altitude support and alignment	2.0
Motor support structure and separation	5.0
For interface (bus and connector)	1.0
Retrorocket test stand	1.0
<b>Total lunar capsule</b>	<b>524.8</b>

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## ACCESS Shows Newest Data Link Ideas

By Philip J. Klass

**Washington**—Aircraft Communication-Electronic Signaling System (ACCESS), a new data link recently proposed to the Federal Aviation Agency by the team of Motorola and General Precision, Inc., reflects many changes in thinking on data link requirements that have resulted from two years of FAA testing on an experimental system.

When FAA purchased the experimental ACACS (Air-Ground Communication System) from Radio Corp. of America three years ago (AW July 25, 1975, p. 75), one of the major objectives was to use it to establish the operational and technical requirements for data link.

Out of those tests at FAA's National Aviation Facilities Experimental Center at Atlantic City, and studies by the Transport Area, have come the following conclusions:

- Use of push buttons for communications between pilot and controller is out as easy or natural as conventional

voice communications for most functions.

- Flexible format message capability is needed for transmitting to aircraft such things as long flight clearance and weather advisory information, with provision for providing pilot with printed ("hard") copy of such messages for future reference. (Existing RLA systems lacked these capabilities.)

- Data and voice should be transmitted on a single radio channel (multiplexed) to enable existing airborne radio/transmitters to handle both services and to simplify pilot tuning procedures.

The characteristics of the ACCESS system generally reflect current thinking in FAA and ATA as a result of considerable time which Motorola/General Precision engineers spent in discussion with FAA and ATA engineers before preparing their proposal.

In the proposed new system, the only pilot control device in the cockpit would be a small motion-display unit containing four push buttons, two of which also contain lamps that illuminate their respective push-buttons under

certain conditions. The function of these push buttons is as follows:

- **Fix request.** When pilot passes over a request fix, he depresses this button which automatically transmits data link message, when aircraft is next interrogated by the ground data link, advising traffic controller and/or traffic controller of aircraft identity and its true over the fix.

- **Acknowledge.** When the controller or traffic control computer transmits a message to its aircraft that requires a pilot response, the ground-to-aircraft message includes such a request which automatically lights the bulb behind the "acknowledge" button on the pilot's motion-display unit. To indicate receipt of message and acknowledge, the pilot pushes the button.

- **Audio alert.** If the pilot does not wish to maintain continuous voice communication with other aircraft, he pushes the "audio alert" button which releases his microphone each time as controller initiates a call to his aircraft.

- **Pilot entry.** When the pilot wants to talk, he starts with the controller, he



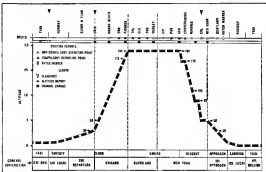
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**SAMPLE FLIGHT PROFILE** from Chicago to New York shows three different constant power/distance and eight constant changes of frequency under present system. Total voice message under present system is 118. ACCESS would cut voice message by more than 50%; would reduce total transmission time 47.5%. Reduction of communication options by average type and time is shown on chart on p. 185.



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pushes the "pilot entry" button which causes a display on the controller to come up to indicate the identity of the aircraft that wishes to communicate.

#### Voice Communications

When the controller is free to talk to this aircraft, he pushes buttons which transmit data link messages to the specific aircraft, setting the volume level of its receiver and flashing a light on the pilot attention display unit. The pilot then communicates by voice in a conventional manner. This procedure eliminates the need for the pilot to monitor other communications while waiting for an opening.

In the event of an emergency, the pilot always can break into existing communications at he would today. For transmitting weather and clearance messages to the cockpit, ACCESS requires use of a small airborne teleprinter which would type out messages for permanent pilot reference (AW Aug. 7, p. 41). Such a device is under development by Moxy Corp., Passaic, N.J., under FAA sponsorship. The tiny airborne teleprinter, measuring only 11 x 9 1/2 x 5 1/2 in. deep, prints 35 characters per line on wide alphanumeric roll paper. Design objective calls for print speeds up to 300 characters per minute.

Print-type model is scheduled for delivery early in 1967 for FAA evaluation. In production quantities, the airborne teleprinter is expected to sell for \$150 to \$1,000, a Moxy Corp. spokesman estimates.

The message transmitted via data link may be weather data stored in a computer memory device, rendered changeable electronic comments selected by the controller, or messages composed by the controller using a conventional teleprinter keyboard.

#### Message Selectivity

Such extended messages can be addressed to one or more specific aircraft, or to all aircraft under the jurisdiction of the controller, at his choice. Where acknowledgment is desired, this request is logged onto the data link message in previously described.

An additional feature of ACCESS is its capability of automatic reporting of altitude, altitude, bearing and distance to a VORTAC station, upon request from the ground, without requiring any action by the pilot. Information on altitude, altitude, bearing and distance would be obtained directly from digital ports on existing weather/radar display instruments.

Another optional feature of ACCESS is its ability to provide automatic ground-controlled switching functions should individual aircraft. For example, when an airplane is leaving one controller's sector and must change to a new radio frequency, this could be accomplished directly from the ground without burdening the pilot. Similarly, the altitude mode beacon transponder could be automatically switched to altitude reply code without action by the pilot.

For smaller aircraft, Moynolds and General Precision propose a miniature airborne digital equipment (MADE), which would provide safety data, report, acknowledge and pilot entry features. Such a MADE system is expected to sell for \$1,000 or less, a company spokesman says.

Among that need and one called the small airborne teleprinter could add the device as an optional item. Airframe and large engine aircraft might go all the way and install the airborne position reporting and switching equipment.

For operators who use, need extensive weather advisory data, high speed airborne teleprinter and better storage units could be added.

#### Technical Details

Here are more of the basic technical details of the proposed ACCESS system.

• **Modulation:** Frequency Modulation (FDM) in which phase of one radio wave is shifted 90 deg. to generate distinguish-



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ing "word" and "space" information. Selection of PAK makes it possible to use existing airborne data equipment without modification. Motorola says:

- Code Field data code essential to receive a military standard, makes proposed system compatible with existing stock and systems. The Field data code employs right left key character and word/space/pause-clock buttons.
- Bit rate: Present plan calls for even lower bit rate of 1200 per sec. with slower rates of 600, 180, 150 and 75 per sec. available when required by low quality, low-density transmitter control and radio transmission. For long distance data link, receive using high

frequency radio channels, a bit rate of 10 per sec. would be required.

- Message format: Versatile length messages containing three communication channels. Followed by four aircraft address (aircraft) characters and one information state of the message. The message, split, containing up to 218 characters is terminated by an end-of-message character. Total time to transmit a 218-character message would be approximately two seconds.
- In operation the ACCESS system would function as follows: A self-call of aircraft extended to be approximating a six-point fixed on their flight paths would be initiated automatically to traf-

fic control computer. Each of the aircraft interrogated would reply, giving the airplane identity and an indication of whether the pilot has departed his fix point button since the last status response. When such information is received, the computer light pilot would be automatically updated and the aircraft would be removed from self-call until the time for it to pass another fix point.

Approximately one-third of a second is required to interrogate each aircraft and receive its reply, which was also valuable pilot request for voice contact, during self-call. The self-call is repeated every 10 sec. Normally there would be only one or two aircraft involved.

For other aircraft under a controller's jurisdiction, which are not approaching a fix point, the system would transmit periodic "all-call" interrogations which in effect act as one of them with to talk to them to the controller. For those aircraft whose pilots have pushed the pilot-call button since the last all-call interrogation, a reply will be transmitted back to the controller's console indicating which aircraft seek voice contact.

#### Entry Response

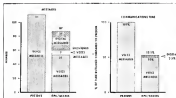
This pilot entry system is transmitted back to the aircraft, immediately after the data is received to minimize the risk of interference in the event that two or more aircraft on a single channel request voice contact during the same all-call interrogation. If interference does occur despite this provision, some of the responses will not get through to the ground until the next all-call action.

Although the use of time-sharing (time-division multiplexing) for voice and data on a single radio frequency uses extensive equipment and pilot training requirements, it does mean that any voice transmission can interrupt the flow of data.

If the ground transmitter is sending out a self-call or all-call message at the instant the controller issues his voice-phase button, there may be a delay of perhaps a second until the data transmission is completed and he can talk even the ground transmitter for voice. If an aircraft voice transmission should occur during a data transmission the latter will be interrupted but will be repeated again 10 sec. later. Such interruptions are infrequent and even when they do occur, they are not expected to be significant.

The number of aircraft voice transmissions interrupted will depend in part upon the percentage of aircraft that are equipped with ACCESS since the data link is expected to be used for voice communication.

The current design envisaged is such that ACCESS can begin to reduce voice



GRAPHS SHOW DECLINE in voice and total transmission time which could be expected after installation of ACCESS data link system. Messages during flight from Chicago to New York would decline from 111 to 97.

traffic as soon as even a few aircraft are equipped according to Evan Ragland, project manager for Motorola's ACCESS project.

In one typical flight profile studied in Motorola's C-30, involving a flight from Chicago to New York, it was estimated that the use of ACCESS and traffic control computer could cut channel time by as much as 10% while reducing the number of voice messages from 111 to 97 according to Ragland.

Motorola and C-30 have proposed an 18-month program to FFA and under which the two companies would develop and deliver 10 miniature airborne digital units, plus associated air base page printer and instruments for

airborne position reporting. Additionally, equipment required for use by the controller and to monitor the operation of ACCESS from a traffic control computer would be provided. Cost of the program is expected to be approximately \$15 million.

Whether FFA decides to proceed with this or other data link development will depend upon the system recommendations of the forthcoming Project Bessac task force report and action subsequently taken by FFA Administrator Nilsen.

The Project Bessac report is expected to recommend use of airborne radio beacons for automatic altitude reporting, a function which also can

be performed by ACCESS and other types of data link.

It is generally agreed that a major advantage of data link is reduced when it is used to provide a direct data report to digital computers and digital link for clearing computer stored altitude data to aircraft where human controller interaction is not required.

As the time that Motorola and General Personnel forces to make the ACCESS study and subsequent proposals the use of automatic traffic control system which the latter had developed for FFA was expected to be the conversion of the future traffic control system. Motorola was to be the ACCESS prime contractor with responsibility for the overall system, while General Personnel was to be the prime contractor in integrating the data link with the controller console and computer.

Advance information is available in the Project Bessac report stating that it will recommend a major change in philosophy in which radio and data scope will form the primary reference for traffic sequencing and conflict prediction.

The specific recommendations of the Project Bessac report on the role of computer, and the degree to which these concepts are accepted by FFA Administrator Nilsen, will largely determine the future of data link development sponsored by the agency.

#### AIRLINE FILTER CENTER

► Lightweight Inertial Navigation for Radio-Gyro-Airframe Systems will utilize lightweight inertial navigation for the Air Force under a costly program to equip Military Air Transport Service, and possibly commercial aircraft operating in the West India air corridor with navigation units that cannot be jammed (AW Oct. 3, p. 15).

► Biostatic Systems Incorporated - New York, New York - has developed a new self-powered and market a line of Bessac Co.-developed optical biological detectors and related gear for defense and laboratory use. In addition, the company has entered into a contract with the Air Force Research Office (AFRO) to develop a new self-powered and market a line of Bessac Co.-developed optical biological detectors and related gear for defense and laboratory use. In addition, the company has entered into a contract with the Air Force Research Office (AFRO) to develop a new self-powered and market a line of Bessac Co.-developed optical biological detectors and related gear for defense and laboratory use.

AMPHIBIOUS AIRBORNE TRANSMITTER, capable of providing pilot with a permanent copy of flight channels and weather data is being developed by Man Corp. Device can fit into standard panel and print 600 characters per minute.



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Tubeless and assembly, a flat disc is construction of various. Many four-quadrant antennas mounted on ground support are being transferred into and of the antenna feed line. Special Phelps Dodge coil sections are used to link the feed to the display and four-way power dividers.



Quadrant elements, ready for placement on pedestal moved. End-mounted is pre-assembled in nearly the laboratory.



Completed quadrant elements are raised in platform for placing into position on pedestal track.



An example of a cable element and coil section inserted into the Beam-Equator array. This element serves as a separate unit that can also be used as a portable with high frequency antenna.

## Foamflex® Coaxial Cable helps put and keep this advanced antenna system on the track!

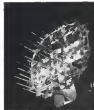
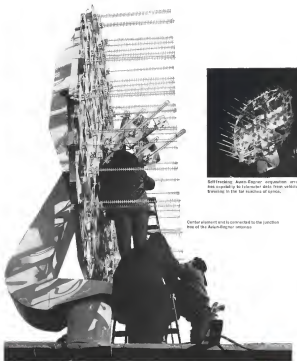
A feed network of 36", 50 ohm Foamflex coaxial cable is a critical part of the fully automatic Avion-Bogner acquisition and tracking antenna that represents an advance in the state of the antenna art. The efficient operation of this sensitive antenna is greatly increased by the low loss, high phase stability and electrical uniformity of its weatherproof Foamflex feed line assemblies. Special connectors, designed and fabricated by Phelps Dodge, link the Foamflex lines to double-tuned, strip-line, four-way power dividers in each quadrant element of the antenna.

Designed for Edwards Air Force Base, this modular array is assembled from identical quadrants, each equipped with power dividers, dipole antennas and capacitor elements. In contrast to the heavier, flat-type parabolas, the lighter, smaller Avion-Bogner model costs less, yet has high acquisition capability for

telemetry information through the use of three automatic tracking modes. Quadrant elements may easily be replaced when changes are desired in frequency bands, due to the simple design and construction of this antenna.

The feed system was planned, fabricated, calibrated and installed by A-T Electronics, New Haven, Conn. Accuracy, uniformity of electrical length for each cable was maintained from cable to cable within one degree at 2300 megacycles after bending.

The outstanding qualities of semi-flexible, sheathed Foamflex have been proved in a number of applications where low loss, long operating life and a low noise to high signal level ratio are essential. If your specifications call for a coaxial cable of the highest efficiency, we recommend you investigate the capabilities of Foamflex.



Self-tracking Avion-Bogner acquisition array has capability to tolerate data from vehicles traveling in the far reaches of space.

Center element and is connected to the junction line of the Avion-Bogner antenna.

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# AERONAUTICAL ENGINEERING



VICKERS-ARMSTRONG VA-1 hovercraft research vehicle tested for demonstration run. Control problems at 30 kts are being worked.

## Advanced 24-Passenger Hovercraft Under

By Robert J. Coleman

South Merton-Vickers-Armstrong (South Merton) Ltd., is continuing its concentration on development of commercial hovercraft vehicles and is moving at "solid" business within five years, in a world market.

Company now is deeply involved in flight testing and follow-on research, using its VA-1 vehicle (AW Sept. 4, p. 15) on both South Merton runways and grass and for water runs at Southampton, about 50 mi distant.

In addition, the company is well into construction of a VA-3 24-passenger hovercraft, and is working to build a VA-2 which will carry four or five passengers and will readily be used for world demonstrations.

The VA-3, for which no firm price has yet been worked out, will be powered by four Blackburn-Tanaka 600 turbine engines, two based to turn lift fans which provide the air cushion, and two mounted externally at the aft end for propulsion.

Follow-on vessels, still under the design stage, are a VA-4, weighing about 100 tons, and a VA-5, of about 225 tons. Vickers-Armstrong expects in addition to these other British developments in the field.

•Woodhead Aircraft's Saunders-Roe Division, in association with Hovercraft Development, Ltd., is completing the SRN 2, a 27-ton craft, at Cowes in the Isle of Wight and will start test runs early next year. This version will carry 66 passengers and will be powered by

four Blackburn A-119 free turbines, pushing it to 70 kts plan speed. A 180-ton version also is projected.

•William Dwyer & Sons, Doncaster shipbuilding firm, has built a 4.5-ton vehicle, exploring designs which it wants to test in the water, and is working on a larger version which will come out next year.

•British-Norfolk has at Carlislecraft on trial runs, powered by a Rolls-Royce V-8 conventional engine and carrying 10 persons. This is a company licensed parent independent of collaboration with Hovercraft Development.

•Poland Aircraft has built a ground effect research machine (GERM) for

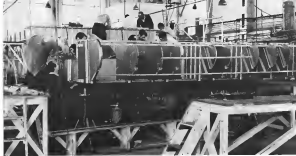
study of a range of what it calls "hover tracks," primarily cargo carriers with speeds up to about 18 mph, and designed for rough terrain.

Waterford has been given standing by British Commercial Aircraft as a potential Channel-crossing vehicle, and the government is participating through an National Research Development Corp., of which Hovercraft Development is a subsidiary. However, its independence status, already has requested hovercraft status in the future G. K.

A prime mover in this area is Hovercraft Development's G. S. Goddard, creator of the hovercraft principle and who leads the program at getting



VARIOUS SUCKET and skirt shapes to enable water spray are tested on this vehicle.



REAR VA-1 CRAFT, which will carry 24 passengers, is under construction at South Merton. Photo shows forward end.

## Development

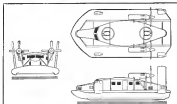
for too little emphasis (AW Aug. 28, p. 57).

At Vickers-Armstrong, the director and general manager, S. P. Woodley, is quick to point out that the VA-1 has no commercial applications and is purely a research vehicle. Currently, tests are continuing on control problems at speeds of about 10 kts, and control of spray through a varied range of ducts and vents.

Nevertheless, it is a Commercial engine but hardware has been kept sufficiently uncomplicated to allow the company to use a variety of engines. The VA-1 now runs on an jet engine of about 5 in., contained in a large working. The fan and air duct system sprays to alter pitch, and side system are to enable for lateral controllability. Two large fans behind the externally mounted propeller and engine provide directional control.

The craft officials said, is relatively uncomplicated and designed of an untrained person would take about two days. No one has yet come up with a name for this "person," Vickers has tried driver, pilot and captain to little result.

In this respect, however, is a problem as yet unsolved. Vickers-Armstrong's research vehicle has an Air Registration Board number showing it is open to public use, but officials at South Merton are convinced that a new set of rules must be written when the concept has reached commercial maturity. Six was made its application to the Air Transport Licensing Board, which has



VICKERS-ARMSTRONG VA-3 three-run is above, wind tunnel model of VA-3 below.





*Mercury capsule's all-titanium frame of two sections, wing ribs and machined rings.*

**45,000 inches of welding**

## **Titanium** construction clinches record of reliability with Mercury capsule!

Mercury's achievement, and all that was at stake with this, rode out the big shot safely in a titanium structure. Chosen for its high weight, its strength and rigidity at high temperatures, its ease of fabrication, titanium has passed another milestone in its growing history of reliability.

Project Mercury's pressurized capsule, its antennas and parachute housings and the adapter section mating it to the booster are basically titanium structures. They consist of a titanium inner skin attached to a framework of titanium stringers and ribs. Beryllium and Kevlar 49 have shielding "hangars" are fastened to the outside of the capsule.

The use of titanium has saved "considerable" weight over other metals of similar strength and endurance in the 48-cubic-foot weight battle in the Mercury capsule and adapter section where ounces were fought for.

This report has been prepared by Titanium Metals Corporation of America in the belief that performance of titanium in the space capsule may provide information of use to you in design and construction of weight-critical aerospace structures, whether they be in VTOL or STOL aircraft, or vehicles to operate in space.

**Rigidity and strength at high temperatures....and 20 G's!** Shaving off pounds was not enough for Mercury's designers. One of the big factors in the selection of titanium, which is as strong as most steels, yet weighs 44% less, is its ability to retain its strength and rigidity at high temperatures.

During the launch phase, the all-titanium adapter section reaches 600F. The titanium stringers in the capsule reach 600F during re-entry; the outer skin reaches 200F. Here titanium construction proves its high performance and reliability. Mercury capsule is designed to withstand 20 G's.

Titanium construction inherently rigid. Titanium lends itself to an equally stiff construction even though its modulus is somewhat lower than steel's. The answer is a greater cross-section made possible by the low density titanium. Moreover the metal will retain its stiffness over a wide range of temperatures.

Added stiffness and efficiency can be gained by "rip-stitching" or bonding. Mercury inner skin, which is also the outer inner wall, consists of two layers of 0.008" aluminum by pure titanium, welded together to form a single "sandwich" structure. The outer layer is flat-rolled. The outer layer has been diffused with corrosion approximately 5 inches in length and 1/4 inch wide. The result is a 0.008" aluminum section that is equal in rigidity to an 0.008" section. 100% increase in efficiency.

**45,000 inches of reliable welds per capsule.** Project Mercury capsule, in addition to its high G loadings and temperature requirements, is presented to maintain its shape at launch life. Welds must be reliable.

According to McDonnell Aircraft Co., St. Louis, Mo., developers and manufacturers of the capsule, there are 24,500 inches of seam and butt weld and 20,500 inches of spot weld in each capsule....45,000 inches of welding. The performance has been repeated in 20 production capsules.

Here welded is a better focus on the reality of titanium welding!

All fusion and seam and spot welding was done "open air." Fusion welds were inert-gas shielded, tungsten-arc, using trailing and backing shields. Welds are as strong or stronger than parent metal. McDonnell reports.

Spot and seam welding was accomplished as standard progressive equipment, with techniques similar to those used on the stainless steels.

**TICA: your information source.** If your inside or outside problems involve special requirements for a rigid, high-strength structure at temperatures from minus 451 to plus 1900F, with high corrosion resistance, including immunity to atmospheric attack, there are many ways to your best answer. The reliability on which the makers of the Mercury capsule placed their faith can work for you.

We suggest you get in touch with the nearest Titanium Metals Corporation of America sales office or write directly to our Technical Service Department for information on titanium applications... fabrication... component fabrications. Why not write today...



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*Titanium inner skin consists of two titanium outer skin high by 1/4" at base welded together. Caps are formed from rip-stitching sections, then welded together. One side consists of 0.008" bonded titanium, the other side of the outer skin of flat-rolled 0.008" titanium. After hot-rolling, this core is individually pressure treated.*



*Caps are joined by seam welding; the bonded core on the outside following spot welding for pressure. Approximately 24,500" of seam weld are used in each capsule. A considerable gap is made between each corrugation and a narrow gap adjacent to the corrugations. Joined caps are also proof-tested.*



*Basic titanium capsule structure consists of welded, two-layered skins which are spot welded to the titanium frame. The heavy titanium frame sections are not pressurized and consequently the skins are bonded to the frame in these areas.*



# ROHR WINDS UP LEADING THE FIELD

The industry's first tape-controlled, continuous-path filament winding machine is in full production now. Designed and built by Rohr, it wraps glass fibre filaments with amazing precision to form lightweight structures of great strength, such as the rocket motor case shown below. It is capable of winding parts up to 25 feet in length and 8 feet in diameter—and has the ability to wind an infinite variety of patterns, including a continuous filament pattern for multiple-nozzle motor cases. Actually, the wrapping of different pressure vessels is as simple as changing the tape. This advanced machine demonstrates Rohr's unique skill in designing and building highly specialized manufacturing equipment... plus knowledge gained from years of programming and production of three-dimensional parts by numerical control. The ability to produce precision-wound products on this new filament winding machine demonstrates the breadth of our research into plastics and adhesives and the depth of our experience in collapsible mandrel manufacture. (Because it achieves such precise and uniform positioning of filaments, this Rohr machine now offers the industry the capability to provide close to maximum strength of material in filament-wound structures. Plus, of course, important cost-reducing speed and flexibility.



## ROHR NUMERICALLY CONTROLLED FILAMENT WINDING MACHINE

For information on this and other products, techniques please write Mr. A. B. Campbell, Sales Manager, Dept. 44, Rohr Aircraft Corp., Chula Vista, Calif.  
Main Plant and Headquarters: Chula Vista, California / Plant: Hawthorne, California / Assembly Plants: Winder, Georgia; Auburn, Washington



**ROHR**  
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toles to action yet, since, unofficially, based members are not vice versa—control is thus central.

In the meantime, work is being accelerated on the VA-2 and VA-1, with the VA-2 kept to a 13 ft. 4 in. length to facilitate adding to conventional systems. This vehicle will use three general purpose engines, one to provide a 9.5 ft lift engine, and the others for propulsion.

The VA-3, Vulture-Antelope, class, will operate in oval orbits and under thrust, with wings up to 2 ft.

Range will be about 50 mi. max., carrying 24 program plus core, or as fitted to cargo configurations with a 4,000 lb. capacity.

### Main Structure

Main structure, mostly of aluminum alloy, consists of a fuselage tank and ducting system. Fuel tank is divided into two compartments, each with its own submerged fuel pump; compartment can be linked by a cross-link.

Cockpit is a forward cab, with controls and equipment for a single operator. Room is available for another crew member.

Future research is concentrated on development of flexible structures to take impact and stresses and has already been tried with rubber clamping and even in the SRN-1. Also problems in structural life and the computer, and it was taken up to 10 years to develop a semi-automated mechanical device.

### Skid Computer Device Derived From B-70

Los Angeles—Computer-based air skid driver for high performance aircraft has been developed to improve the speed of rotation of the main landing gear wheels with that of a mainline landing gear wheel, thereby extending a reserve of air wheel slippage.

The idea emerged from the North American B-70 supersonic bomber program. The airfield computer would use information on slippage, wheel load, brake torque and speed to calculate when a skid is about to begin. The system would then modify brake pressure to prevent the skid. The air skid of the system also provides a better indication of ground speed than earlier methods have had. North American claims that the fifth wheel anti-skid device would enable the B-70 to land on an runway capable of handling the Boeing B-72.

The landing gear selection and the brake control system for the B-70 were developed by Cleveland Pneumatic in darders and the wheels, landing gear were designed by the B. F. Goodrich Co.



*The Lincoln Laboratory program for ballistic missile range measurements and penetration research includes:*

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Five of first nine HU2K-1s in ready flight status fly over Kansas's Goodland, Okla. facility. Nine more fly on route to Hahn.

## Five of Nine HU2K-1s in Flight Status Fly Formation



While took on fourth Navy transport from right above in its earlier test work, Kansas has produced 15 of the helicopters to date. Next steps in the HU2K program are structural reinforcements and final of inspection series at NAB Fort Worth, Tex. Although the HU2K-1 was designed as a utility rescue aircraft, it is being adapted for reconnaissance warfare tasks. Kansas recently received a contract from the Navy to install ASW gear on the helicopter. Status status consists of four blade main rotor and three blade sub-rotor rotor.







# AIRCRAFT DESIGN ENGINEERS



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is  
the  
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Engineering is now underway on the strong looking bird pictured here. We call it the "Hummingbird," and we are developing it for the U. S. Army. It is to utilize the jet ejector augmentation principle for VTOL aerial vehicles to fly straight up, straight down, hover in mid-air, and convert to conventional forward flying at speeds in excess of 500 miles per hour. Just one example of what is going on here at our Engineering Center where dreams come true. Like to join us?

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from 100 to 1200—that is, from 12,450 to 14,100 g.p.m.

How could throttle position the throttle valves are open, and the valve further limits a coefficient. During rapid acceleration the throttle was stuck at position at which these valves are set (about the same pressure had had time to rise about 20 psi). However, in the event the throttle is not completed the poppet will go toward the forward position. The pressure is very short duration and does not last about the working area.

If partial right should occur the throttle will be closed and opened up to about 12,000 g.p.m. to effect a complete change. In the event the valve does not achieve a complete right, it is then actuated in reverse and vice versa, causing the fuel delivery before repeating the cycle. However, in an emergency, as an emergency, no cover attempts to right may be made.

## High Pressure Cock

In the event the high pressure cock is not placed in the throttle position (the gas to the poppet not furthering, but could collect in some parts of the reaction chamber. In addition, if the throttle was partially open and the fuel delivery cock opened to allow introduction of pressure and opening that could be a complete right. This action could be repeated a few times within the 10 seconds right time-out cycle, then giving rise to a "popping" noise."

At about 1000, the Board believed Nos. 1 and 2 poppets were into forward—condition which is a minimum. The fuel feed in the most case of the No. 3

cocking cockers of these poppets. For example, if the fuel cock is not in the poppet position, the high pressure cock was in the open position.

The Board believed that the most likely cause of the cocking was the poppet cocking inside and the known procedure for repositioning a right of fuel supply, required of an attempt to close the gas poppet out of fuel. In repositioning fuel cock to multiple attempts to right may be made. Success might be attributed to the fuel cock being actuated in promoting advancing of the throttle position to complete right.

During the emergency, No. 3 engine poppet was found completely closed. This closed state condition is to achieve such a condition could be a factor in delaying right of No. 1 engine cock, as per to inspect. The quarter boxes of all four engines were benchchecked and found to be capable of operation. Inspections revealed that the engine failed in these quarter boxes was the result of time to service were evaluated and not a contributing factor in the accident.

## Change Dissemination

During the investigation of this accident the Board discovered that the Change No. 112 to the A-1H Flight Manual had been disseminated to all Vietnam operations for a period of 77 months prior to the accident and embodied in the manual carried in the Cockpit A-1H Vietnam, but the manual had not been disseminated into the Capital A-1H Flight Training Manual Manual to all the Capital Vietnam pilots and utilized in the ground school

instruction for A-1H Vietnam. Nor was this manual incorporated in the pilot company and service checklist.

The Board's investigation of this accident revealed further that in the case of and subsequent to the accident, every Vietnam pilot of Capital A-1H were not aware of the change to the gear reduction system, at plus 10°C instead of at plus 9°C, despite the fact that this change became effective July 1973.

## Conclusions

After an evaluation of all evidence, the Board concludes that Capital A-1H Flight No. 112, 1973, involved an accident of sufficient cause to Hazardous VFR, which was contributory to the accident because of certain discrepancies in the existing manual, several engines failed and due to delayed testing of the Vietnam engine experiment system, that in efforts to re-ignite the engine which had failed, the manual (change) had not been disseminated to all the Vietnam pilots and not all the Vietnam pilots were aware of the change. Several moments prior during which all four engines poppets forward, support decreased and unstable throttle was lost. Engine failure could be a sufficient time to cause a drop in battery electrical energy in A-1H, the engine failure, engine, as successfully reposition a poppet and right to engine. A-1H was shut down just when the research was about to start, the poppet out of fuel by repositioning. The crew was eventually successful in its attempt to drive No. 4 poppet out of fuel and right to engine.

Full power was used on No. 4 engine in

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See Page 164-165

## PROBLEMATIC RECREATIONS 88



An engineer designed 8 boxes of 100 often visitors and 1 box of 118 often visitors. When they started about 100 often visitors in each of the 10 boxes, but both the boxes and the museum were unmarked. How many museum measurements did he have to make to locate the box of 118 often visitors?

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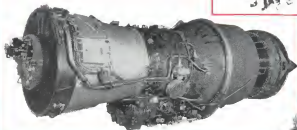








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